

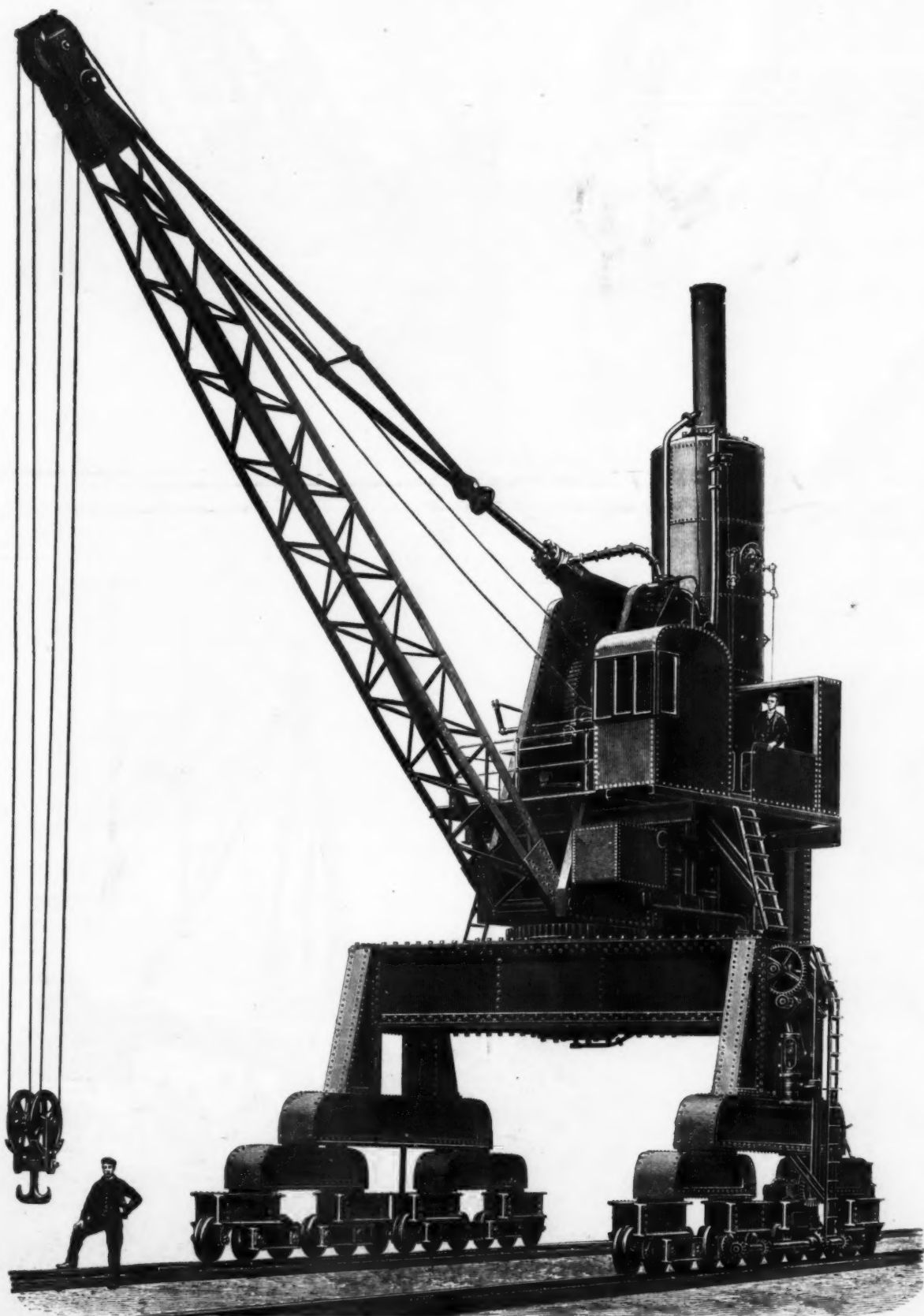
# SCIENTIFIC AMERICAN

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TWENTY-FIVE TON PORTABLE CRANE AT SOUTH SHIELDS

# TWENTY-FIVE TON PORTABLE SELF-PROPELLING STEAM CRANES AT SOUTH SHIELDS.

We illustrate herewith one of two cranes which have just been erected and tested on the new wharf belonging to the Harton Coal Company (Limited), at South Shields. The wharf, which is of wood, has a frontage of about 600 ft. to the river, and has been constructed to the designs of Messrs. Sandeman and Moncrieff, C.E., of Newcastle-on-Tyne, who also prepared the general specifications for the cranes. In these it was provided that the load should be lifted at 60 ft. per minute, and that the crane should be capable of making a complete revolution in 30 seconds. A calculated factor of safety equal to 8 was specified for all parts, while under maximum load the pressure between the wheels and the rails was not to exceed 10 tons. It was further provided that the center of gravity should not deviate more than 5 ft. 3 in. from either side of the center of revolution with the load on or off. The general appearance of the crane is well shown in our illustration. The track on which the crane travels consists of a double rail at each side, with a space between of 2 1/4 in., the carriage wheels having central flanges. The gage is 21 ft. from center to center of the groove thus formed.

The wheel base is 38 ft. 6 in., there being 12 wheels on each side. These wheels are 2 ft. 6 in. in diameter, and are spaced at 3 ft. 6 in. center to center. The whole of these 24 wheels are fitted with Bessemer steel tires.

Each corner of the carriage is supported on six wheels. The maximum radius of the jib is 35 ft. and the minimum radius 25 ft. The radius is very quickly varied between these extremes, by the arrangement described below. The tie rods suspending the jib are attached to the piston rod of a hydraulic cylinder, which is of Siemens cast steel, lined with copper. There are a pair of double acting pumps with gun metal lined barrels, operated direct from the piston rods of the hoisting engines; these pumps can be readily disconnected when it is not required to vary the jib radius. They draw water from a supply tank and discharge back into the same tank, or at option into the upper end of the hydraulic cylinder. When it is desired to lessen the radius of the jib, the discharge to the tank is closed, and the water acts on the piston and lessens the radius at the rate of 1 ft. per second. The radius is increased by allowing the water to escape to the tank.

The main engines for hoisting have a pair of 16 in. cylinders, and are always in gear with the hoisting barrel, by duplicate steel wheels and pinions, single purchase. The link reversing motion is operated by a steam cylinder very quickly, and with little exertion to the driver. There are also a pair of separate engines for slewing, and a third pair of engines for propelling the crane, this being effected by the vertical shaft and bevel gearing shown in the woodcut. These engines also drive a capstan attached to one corner of the carriage for manipulating the coal wagons on the wharf, and putting them on and off the cradle by which they are lifted and discharged into the vessels.

The body of the carriage is high enough to allow two trains of loaded wagons to pass underneath. The boiler is 21 ft. high and 6 ft. in diameter, and is certified by Lloyd's for 75 lb. working pressure. The

total weight of each crane in working order is about 150 tons. The official tests were highly satisfactory in every way, the prescribed conditions being all fulfilled.

The cranes were designed and built by Messrs.

her armament, is one of the most recent and powerful battleships now afloat.

Her high and slightly incurved stem, armed with a formidable ram, her somewhat low, pointed stern, and her rounded sides that bulge at the load water line,



THE DERRICK AND THE TWELVE INCH GUN.

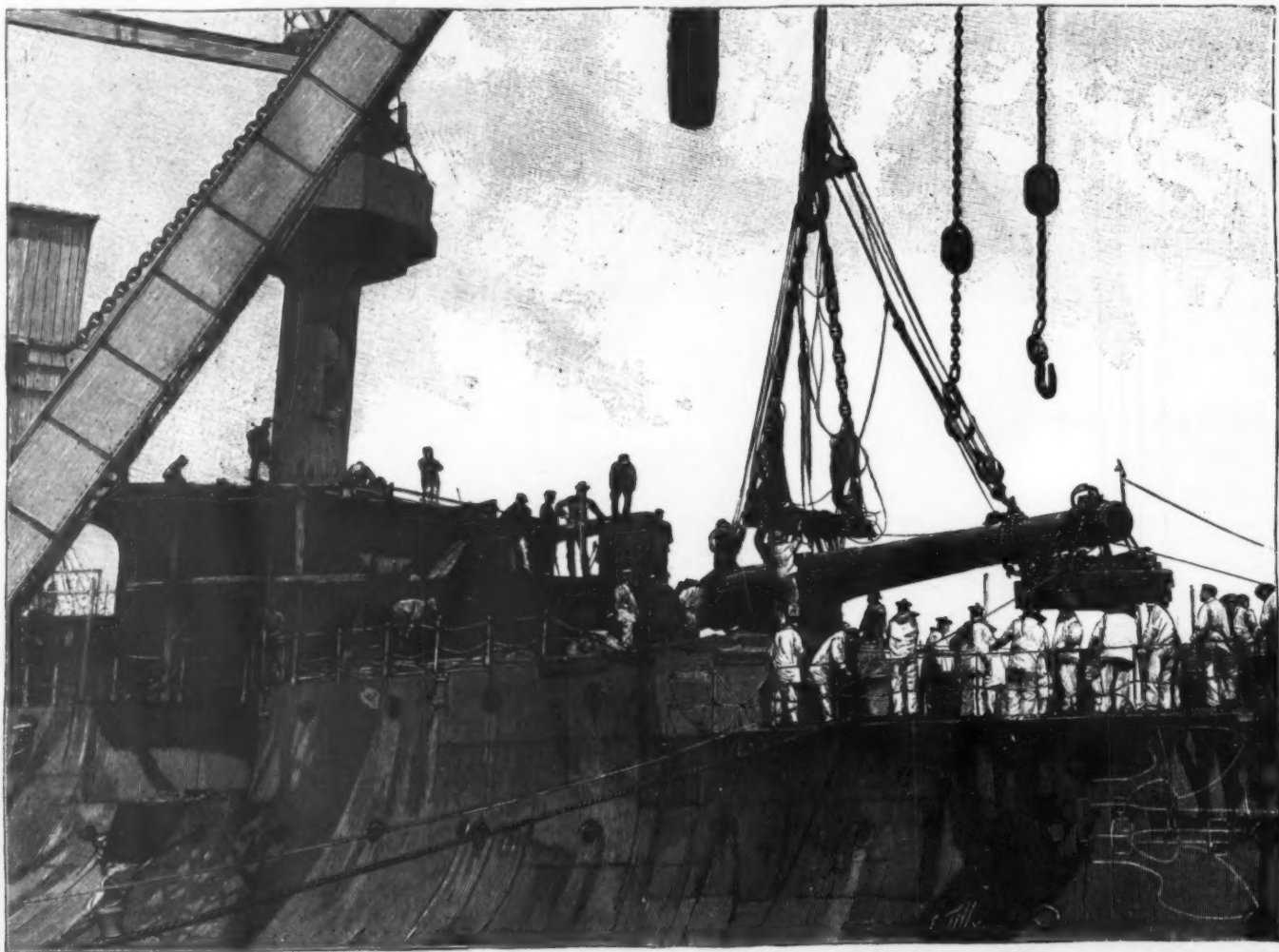
George Russell & Company, of Motherwell, near Glasgow.—Engineering.

## THE BOUVET AND HER NINETY-NINE THOUSAND POUND GUN.

THE French armored ship Bouvet, which, at the beginning of June, entered upon the most active phase of

represent her well seated upon the water and will certainly contribute toward assuring her stability, even upon the roughest sea.

The extreme fineness of the water lines necessary for the speed of 17 1/2 knots that the vessel must make, and the very compressed form given her topsides at the median part, so as not to interfere with the field of firing of the guns of the side turrets, but to allow them



PUTTING THE TWELVE INCH GUN IN PLACE ON BOARD THE BOUVET.

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to have their maximum effect in direct fire aft and ahead, give this mass of steel of more than 12,000 tons displacement an elegant appearance.

It is especially during this period of armament, while the vessel, still light, is sitting high above the water and thus showing her entire belt of armor, that it is possible to obtain an idea of her great defensive power. This is carried to the extreme on the Bouvet, where the protective belt of more than six feet in height and 16 inches in thickness extends from stem to stern, thus strengthening the ram with its entire mass, but at the stern assuming a very hollow tapering form to prevent the eventual shock in the axis and protect the rudder and three screws.

An armored deck  $2\frac{3}{4}$  inches in thickness rests in the form of a turtle's back upon the upper edge of the belt of armor, in order to assure the protection of the most valuable and delicate belongings of the vessel. To prevent the great damage that might be caused by rapid fire light artillery, and by shells filled with powerful explosives, in the immediate vicinity of the load water line, the ship has been covered with a second cuirass, above the principal belt, but only  $3\frac{1}{4}$  inches in thickness, and with an armored deck especially designed to prevent the entrance of water and allow the vessel to preserve its equilibrium in case of grave damage being done it.

The offensive power of the Bouvet resides less in the number of her guns than in the extreme care taken to protect them against the fire of the enemy.

The 10 $\frac{3}{4}$  and 12 inch pieces, which form the most important part of the armament, are each inclosed in a movable turret protected with 14 inch plate and completely closed, and having no other aperture than the one strictly necessary for the muzzle of the piece and for upward pointing.

Our ancestors would be much astonished to see with what ease and rapidity the powerful steam derrick of

and driving brakes, elevators in storehouses, operating letter presses, cutting out staybolt stubs, jacking up cars and trucks, cleaning interior of coaches, cleaning upholstered work, burning paint off coaches, painting cars, sandblast ends of cars, gasoline heater, cutting off staybolts, screwing in staybolts, rivet forges, one blacksmith forge, pressing in driving box brasses, operating flange clamp, swedging flues. They consider it the best means of transmitting power in and about shops.

#### THE GREATEST STEAMER IN THE WORLD.

THE fourth of May of this year saw the launching of the largest steamer of all merchant navies of the world. The twin screw steamer Kaiser Wilhelm der Grosse was built for the North German Lloyd on the dry docks of the Vulcan, at Bredow, near Stettin. Her length on the water line is 190.5 meters, length over all 198 meters. She is 20.1 meters broad; the height from keel to deck, 13.1 meters. The hold represents a volume of 13,800 tons; the total displacement of the ship is 20,000 tons. The boat is built of steel, according to the rules of the German Lloyd, and under the supervision of the inspectors of the German and North German Lloyds, and ranks among the highest class boats.

All possible measures have been taken for the safety of passengers, cargo, and the boat itself, in accordance with the most modern improvements. The ship's hull contains fifteen watertight bulkheads and one machine bulkhead, on either side of which the engines are located. They are independent of one another. By the bulkheads the Kaiser Wilhelm der Grosse is divided into eighteen separate watertight compartments. Throughout her whole length she is provided with a double bottom.

There are two triple expansion engines, with four cranks and four steam cylinders, which lie one behind

Our cut represents the gigantic steamer standing on end beside the spires of the Cologne Cathedral. It gives perhaps a better idea of the immense length than any other means could convey. We are indebted for the illustration to Illustrirte Zeitung.

#### A PRESIDENTIAL CAR.

THE Railroad Car Journal has originated a project to build a private car for the President of the United States, from material and appliances contributed for the purpose by the car building and affiliated industries.

It is proposed to construct a private car excelling anything of this kind which has been done before in the substantial character of its construction and in the completeness and convenience of its furnishings and decorations.

The projected car will be a complete exposition of the art of car building, demonstrating to the world the surpassing excellence of this industry in the United States; and it is to be presented to the nation, as a tribute from the car building fraternity, for the personal and official use of the successive presidents.

The designs and specifications for the car are being prepared by the Railroad Car Journal, under the supervision of a committee of twenty-five prominent and representative master car builders and superintendents of motive power of various railroads, thus insuring the end that the proposed car shall represent the skill, ingenuity and experience of the American car builder.

Much of the necessary material required for its construction has been tendered by leading dealers and manufacturers in the railroad supply trade, and the projected movement offers an exceptional opportunity to firms engaged in business which, while not directly associated with the car building industry, make and



THE KAISER WILHELM DER GROSSE AND COLOGNE CATHEDRAL.

the port of Lorient, capable of lifting a weight of 150 tons, proceeds to the putting in place of the heavy pieces that enter into the armament of an armorclad. It is child's play for the derrick to seize, upon the wharf, the huge 12 inch gun, weighing 99,000 pounds, and balanced at the muzzle with one or two tons of pig iron, and then, turning upon its rollers, to place the breech opposite the narrow aperture in the turret. Here the final operation becomes original, in the sense that, in order to cause the gun to enter the turret, gangs of men, working at the capstan, are obliged to cause the 12,000 ton vessel itself to move forward until the breech, on entering the fork, hangs over its carriage.

The artillery of the Bouvet will consist of two 12 inch and two 10 $\frac{3}{4}$  inch guns, eight  $5\frac{1}{2}$  inch rapid fire guns, and thirty small pieces distributed here and there upon the bridges and the military mast. It will have two torpedo tubes, and carry a crew of 31 officers and 600 men.—Illustration.

#### USE OF COMPRESSED AIR IN RAILROAD SHOPS.

THE Illinois Central Railroad at their Burnside shops use compressed air for the following purposes:

Elevating sand at engine sand house, elevating oil at oil house, hoisting heavy castings and parts of machine tools, etc., forcing couplings on air hose, operating cylinder boring bar, operating valve facing machine, filling cylinders of hydraulic presses, removing and applying driving tires, testing water pumps after repairs, drilling with motor, tapping with motor, reaming with motor, cleaning boilers, cleaning machinery, punching jacket rivet holes, taking old paint off tin roofs, rolling and beading flues, chipping, cutting, calking, small bull dozer, elevating water from deep wells, testing air

the other. Besides the two chief engines there are no less than sixty-eight supplementary engines (for electric light, pumping machinery, etc.), with altogether 124 steam cylinders.

To avoid the rocking and the concussion due to the immense engines, these have been balanced in their parts by the well known Schlick system. The two engines will have a horse power of 30,000. They are fed from fourteen boilers, and burn 450 to 500 tons of coal daily. The speed of the boat will be twenty-two knots. There is accommodation for 400 first cabin, for 340 second cabin, and 800 steerage passengers.

The specially large and elegant saloons, throughout of German workmanship and German materials, are masterpieces of German production. The first saloon is built in Italian early Renaissance style; in the recesses are represented the residences of the emperors from ancient up to modern times.

On either side of the first saloon are attached small drawing rooms. The other rooms are finished partly in Rococo style, partly also in Italian Renaissance and Queen Anne style. There are provided a reading room, a music room, smoking room, etc. All rooms are distinguished by the most artistic furniture of excellent taste and comfort. The cabins hold two or three persons each. Besides there are a few state rooms furnished for special occasions. Essential improvements too are made in the accommodation of the steerage passengers, both in their position and in the space and comforts allowed.

The crew consists of no less than 450 men, of which number 208 are employed in the engine room. The ship carries twenty-four steel boats. Another notable feature are the extensive precautions taken against fire, also the huge pumping plant of the steamer. The boat has two masts, and four immense funnels, which give it a most imposing appearance.

supply various articles and materials which will be desired for the furnishing and decoration of so elaborate a vehicle as a private car for the use of the President of the United States.

Offers of contributions of material, furnishings, appliances or utensils should be forwarded to the Railroad Car Journal, New York, for submission to the advisory committee.

#### A RAILWAY HOSPITAL CAR.

CONSUL MORRIS writes from Ghent: The latest novelty in Belgian railroad matters is the hospital car. It serves a double purpose. In the event of a serious railroad accident, the car may be run to the spot, where the wounded may be picked up and carried to the nearest large city for treatment, instead of being left to pass long hours in some wayside station while awaiting surgical attendance. It also enables the railway companies, at certain seasons or upon special occasions, to transport large numbers of invalids to health resorts or places of pilgrimage. This new hospital car entered into regular service April 27, 1897. The interior is divided into a main compartment, a corridor on one side, and two small rooms at the end. The largest compartment is the hospital proper; it contains twenty-four isolated beds on steel tubes hung upon powerful springs. Each patient lies in front of two little windows, which may be closed or opened at will. Each bed is provided with a little movable table and a cord serves to hold all the various small objects which the patient may need.

The corridor on the outside of the hospital chamber leads to the linen closet and the doctor's apartment. In the latter is a large cupboard. The upper portion is used for the drugs; the lower part is divided into two smaller compartments—one serving as a case for

surgical instruments, the other as a receptacle for the doctor's folding bed. The hospital compartment is carpeted with linoleum or other material to deaden the sound of walking. Various trapdoors in the floor, when opened, disclose to view an ice chest, a compartment for the disinfection of soiled linen, and a provision cellar. If necessary, a portion of the hospital chamber may be transformed into an operating room for urgent cases. Finally, as is customary in this country, a small chapel for religious worship is provided. This car will be put in charge of a surgeon, doctor and nurses, and will be chiefly used to carry invalids from Belgium direct to the miraculous cure of Lourdes, in France. The feasibility of the introduction of such a hospital car on American railroads seems to me beyond question; if run, for instance, during the winter season between any one of several Northern cities and certain well known Southern resorts, it would, without doubt, be well patronized.

#### SIX-POLE SEVEN-KILOWATT DYNAMO.

We illustrate herewith a six-pole dynamo, constructed by the Electrotechnische Industrie (formerly Willem Smit & Co.), of Slikerveer, Holland. The dynamo in question has been designed to give a current of 600 amperes at 120 volts when running at 450 revolutions

which are laid six wires, 3 millimeters in diameter, connected up in multiple arc, and carefully insulated.

The commutator bars are of hard drawn copper, insulated with mica, and the diameter of the commutator is, it will be seen, nearly equal to that of the armature itself. Connections of tinned copper are used between these bars and the armature windings. The number of commutator bars is equal to that of the windings, so that the current delivered is extremely steady. These bars are held in place by a clamping ring, and the depth allowed for wear above these rings is about  $1\frac{1}{2}$  in. Mica is used exclusively for the insulation of this important part of the machine.

The armature is not keyed on the shaft, but is secured entirely by friction, two iron rings being shrunk over the ends of the spider tube. End motion of the armature when running is limited by a screwed ring shown at the pulley end of the shaft. There are six sets of six brushes each, and the bearing pressure of each separate brush can be adjusted independently of the rest. At the same time by means of one small handwheel all the brushes can be simultaneously raised from or lowered into contact with the commutator, while a second handwheel provides a means of shifting them round through a small arc, so as to find the non-sparking position. Flexible connections are, it will be seen, used between the brushes and the terminals of the machine.

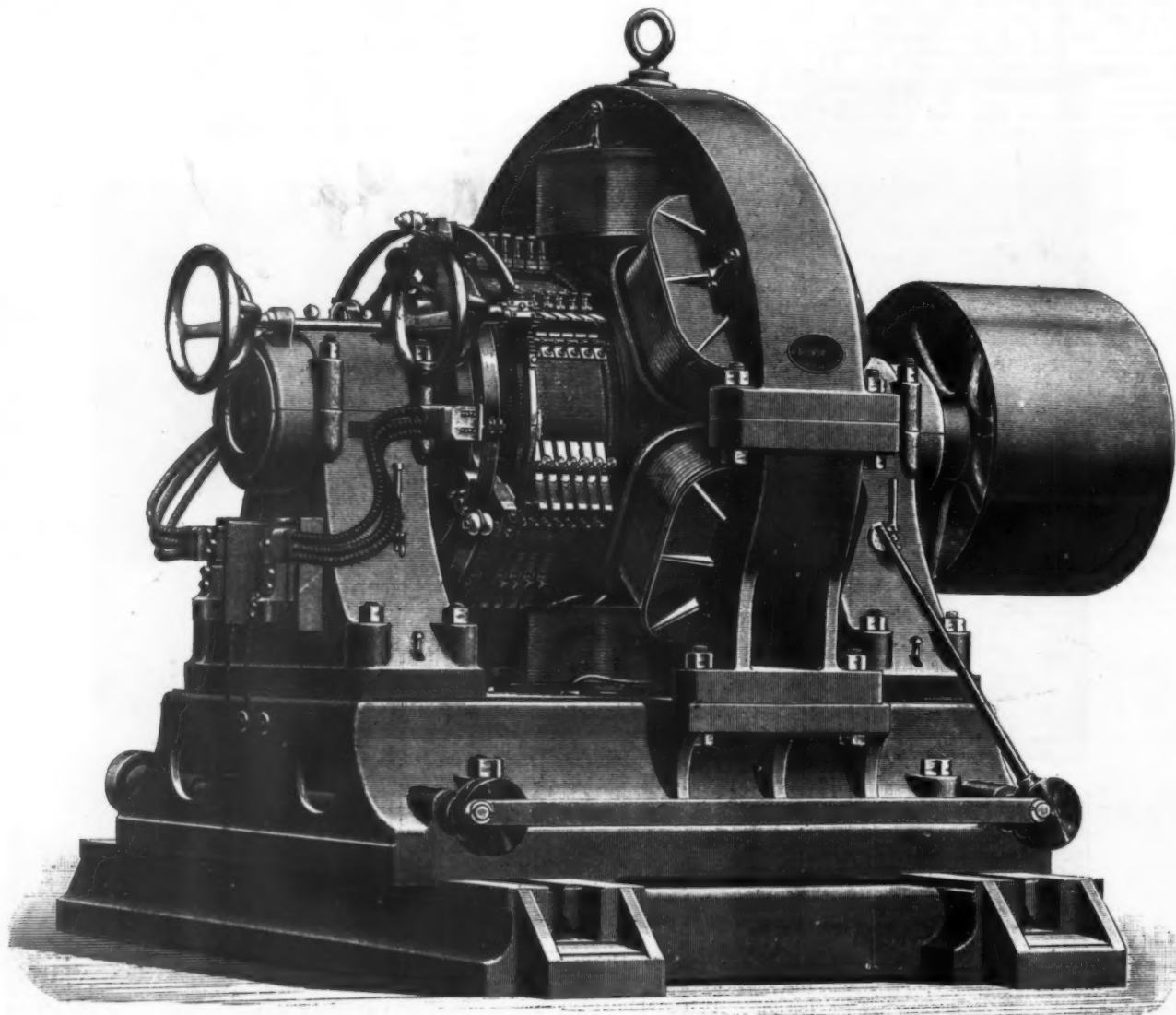
electrical horse power to be delivered by the generator. The work done is the heaviest required of these particular machines:

Circular rip saw, 28 in. diameter; speed, 1,200 revolutions per minute, or 8,800 lineal feet per minute; arbor pulley,  $5\frac{1}{2}$  in. diameter by  $8\frac{1}{2}$  in. face; hand feed; motor belted to saw shaft. Motor and saw, idle, 3.4 E. H. P.; ripping seasoned heart oak,  $7\frac{1}{2}$  in. thick; feed, 10 ft. per minute, 10.3 E. H. P.

Circular rip saw, 34 in. diameter; speed, 1,500 revolutions per minute, or 9,429 lineal feet per minute; hand feed; motor belted direct to 7 in. pulley on saw shaft. Motor driving saw, idle, 3.2 E. H. P.; ripping seasoned heart oak, 6 in. thick, 10 ft. per minute, 12.8 E. H. P.; ripping seasoned white pine,  $6\frac{1}{2}$  in. thick, 15 ft. per minute, 9.4 E. H. P.; ripping seasoned yellow pine, 3 in. thick, 45 ft. per minute, 10.7 E. H. P.

Circular rip saw, 14 in. diameter; speed, 2,200 revolutions per minute, or 8,067 lineal feet per minute; arbor pulley, 3 in. diameter, 5 in. face; hand feed; motor belted to saw shaft. Motor, idle, 0.96 E. H. P.; motor and saw, idle, 2.7 E. H. P.; ripping seasoned heart oak,  $3\frac{1}{2}$  in. thick, 12 ft. per minute, 6.3 E. H. P.

Circular rip saw, 12 in. diameter; speed, 2,300 revolutions per minute, or 6,914 lineal feet per minute; hand feed; belt pulley,  $3\frac{1}{2}$  in. diameter, and 3 in. face; motor belted direct to  $3\frac{1}{2}$  in. pulley on saw shaft; saw



SIX-POLE SEVEN-KILOWATT DYNAMO.

per minute. The general arrangement is very clearly shown in the woodcut. As will be seen, the dynamo is belt-driven, and mounted on a cast iron bed, along which it can be traversed by screws when it becomes necessary to tighten the belts. These screws are coupled together, so that a uniform traverse is automatically secured. The armature shaft runs in bearings of ample proportions, while efficient lubrication is secured by a loose ring mounted on the shaft and dipping into an oil bath, the level of the lubricant in which is shown by gage glasses. The field magnets are formed out of steel castings, the pole pieces being cut out of a separate complete steel ring, and bolted into place. The magnetizing coils are wound on iron spools having end flanges of bronze.

The bearing surfaces are of white metal. The armature is of the Gramme type, and is mounted on a six-armed spider of bronze. These arms are sufficiently long to carry the commutator, which thus makes one piece with the armature proper. The body of the latter is built up of extra soft steel stampings half a millimeter thick, paper being used as the insulator. These plates are stamped in two operations, the first of which produces the central hole and the notches for the spider arms, while the second produces the grooves in which the windings are laid. The whole set of stampings are kept together, not by bolts as usual, but by riveting the horns of a bronze end flange to the corresponding arms of the spider, this work being executed while the disks are heavily pressed together. The winding is laid in 216 narrow slots, in each of

The current required for the field magnets is 12 amperes, or 2 per cent. of the total output of the machine.

#### POWER REQUIRED FOR ELECTRICALLY OPERATED WOODWORKING MACHINERY.

The following is an interesting report of some electrical tests upon the power required for running woodworking machinery, made by Prof. O. G. Dodge, U. S. N., the work having been done at the navy yard at Washington, D. C. It should be borne in mind that a watt is a volt ampere, and equal to  $\frac{1}{746}$  of a horse power. An electrical horse power is equal to the product of the current in amperes and the difference of potential in volts divided by 746. One horse power equals 746 watts, which is the equivalent of 33,000 foot pounds per minute. The results are reproduced from the Electrical Engineer.

In the case of the following tests the mechanical horse power delivered by the motor was determined by tests made under the same conditions as the previous power tests. This was necessary, as in many cases long leads were run to the motor, and the drop was large. In other cases it was necessary to use a rheostat in series with the armature to obtain the required speed. Under these conditions the efficiency of the motor was a variable factor, and a separate test was made in each case to determine the output of the motor. The column of mechanical output is therefore the proper one to use in determining the motor required, and the

set to wobble for cutting grooves. Motor, idle, 0.96 E. H. P.; driving saw, idle, 2.3 E. H. P.; cutting groove in seasoned walnut,  $\frac{3}{8}$  in. by  $\frac{1}{4}$  in., 12 ft. per minute, 3.6 E. H. P.

Band saw pulleys, 72 in. diameter; speed, 160 revolutions per minute, or 3,017 lineal feet per minute; belt pulley, 30 in. diameter, 8 in. face; power feed; motor belted to saw shaft. Motor and saw, idle, 12.1 E. H. P.; ripping seasoned ash,  $10\frac{1}{4}$  in. thick, feed 6 ft. per minute, 16.1 E. H. P.; ripping seasoned white pine,  $10\frac{1}{4}$  in. thick, feed 10 ft. per minute, 16.1 E. H. P.; ripping yellow pine, 13 in. thick, 20 ft. per minute, 18.8 E. H. P.

Band saw pulleys, 42 in. diameter; speed, 350 revolutions per minute, or 3,850 lineal feet per minute; belt pulley, 16 in. diameter, 5 in. face; hand feed; motor belted to saw shaft. Motor, idle, 0.96 E. H. P.; motor and saw, idle, 2.9 E. H. P.; ripping seasoned oak, 12 in. thick, feed 3 ft. per minute, 5.7 E. H. P.; cross cutting seasoned oak, 8 in. thick, feed 5 ft. per minute, 5.7 E. H. P.; ripping live oak, 10 in. thick, feed 3.2 ft. per minute, 5.7 E. H. P.

Band saw pulleys, 28 in. diameter; speed, 480 revolutions per minute, or 3,520 lineal feet per minute; belt pulley, 13 in. diameter,  $3\frac{1}{2}$  in. face; hand feed; motor belted to saw shaft. Motor, idle, 0.96 E. H. P.; motor and saw, idle, 1.7 E. H. P.; ripping seasoned oak, 3 in. thick, feed  $2\frac{1}{2}$  ft. per minute, 2.3 E. H. P.; ripping seasoned pine, 3 in. thick, feed 4 ft. per minute, 2.3 E. H. P.; cross cut seasoned oak,  $3\frac{1}{2}$  in. thick, feed 4 ft. per minute, 2.3 E. H. P.

Daniel's planer, machine bed, 2 ft. 5 in. by 21 ft. 6 in.;

belt pulley, 10,400 ft. per minute; motor belted to driving pulley, 6.2 E. H. P. Hand planing, 3,200 revolutions per minute, 4.0 E. H. P. Cylindrical speed of power feeding, 0.96 E. H. P. planing

minute, 3 in. wide, Boring minute; idle, 0.96 E. H. P. Boring speed, 750 revolutions per minute, 0.96 E. H. P. Pattern minute; idle, 0.96 E. H. P. Carver per minute, 0.96 E. H. P. cutting g, 3.4 ft. per

belt pulley, 13 in. diameter by  $5\frac{1}{4}$  in. face; speed, 350 revolutions per minute; speed of cutting edges of tool, 10,400 ft. per minute; power feed, 12 ft. per minute; motor belted to countershaft. Motor idle, 0.96 E. H. P.; driving machine, idle, 3.9 E. H. P.; planing seasoned oak, cut  $\frac{1}{8}$  in. deep by 30 in. wide, 12 ft. per minute, 6.2 E. H. P.

Hand cylinder planer or jointer, size of machine, 24 in.; belt pulley, 4 in. diameter, 5 in. face; speed, 3,200 revolutions per minute; speed of cutting edge of tool, 4,000 ft. per minute; hand feed; motor belted to shaft of tool. Motor, idle, 0.96 E. H. P.; driving machine, idle, 2.40 E. H. P.; planing white pine, cut  $\frac{1}{8}$  in. deep by 18 in. wide, 25 ft. per minute, 4.80 E. H. P.

Cylinder planer, size of machine, 24 in.; belt pulley 5 in. diameter, 5 in. face; 2,350 revolutions per minute; speed of cutting edges of tool, 3,105 ft. per minute; power feed; motor belted to shaft of tool. Motor, idle, 0.96 E. H. P.; driving machine, idle, 2.40 E. H. P.; planing pine, cut  $\frac{1}{8}$  in. deep, 18 in. wide, 11 ft. per

#### ELECTRICAL PLANT, LONDON CENTRAL RAILWAY.

MESSRS. ERNEST SCOTT & MOUNTAIN have supplied to Messrs. Walter Scott & Company the electrical plant illustrated by the accompanying engravings. In all six engines have been provided, these being fixed at the various stations. Each engine is of Messrs. Scott & Mountain's improved compound central valve, inclosed, self-lubricating type, and capable of giving 35 effective horse power with a steam pressure of 120 lb. per square inch when running at a speed of 350 revolutions per minute. The engines are fitted with cylinders of the following dimensions: High pressure cylinder, 7 in.; low pressure, 13 in.; stroke, 6 in. The central valve placed between the high and low pressure cylinders has been specially designed to avoid friction, the valve being balanced, while the arrangement of the ports reduces clearance. The central valve admitting steam to the high and low pressure is worked from one eccentric and rod, the cranks being placed

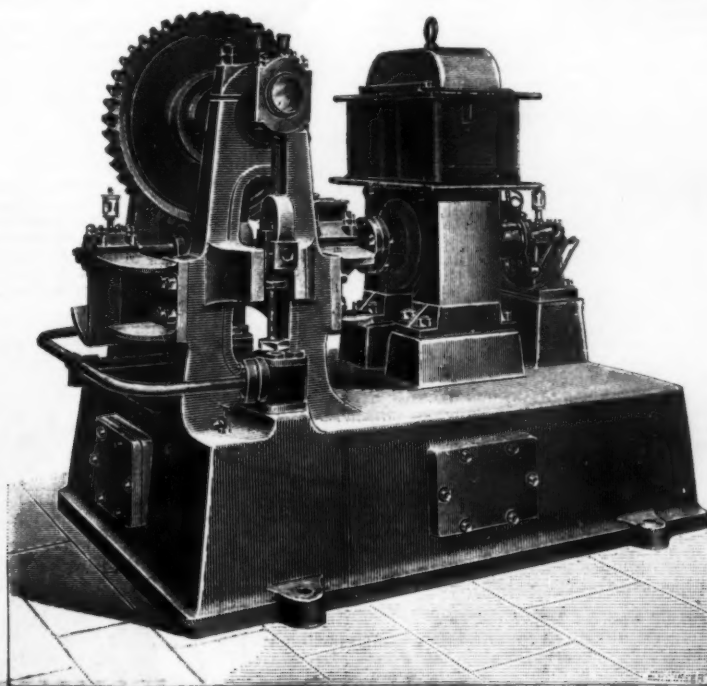
tom of the bedplate to the center of the armature spindle is kept as low as possible to avoid all vibration. The dynamos are mounted upon sliding bedplates with tightening screws and brackets, enabling the slack of the belt to be taken up while running.

The current from the dynamos is taken to main switchboards, on which the instruments are mounted for reading the amperes and volts and distributing switches, and are arranged so that the current is divided into the various circuits, i. e., the locomotive circuit and also the lighting circuit.

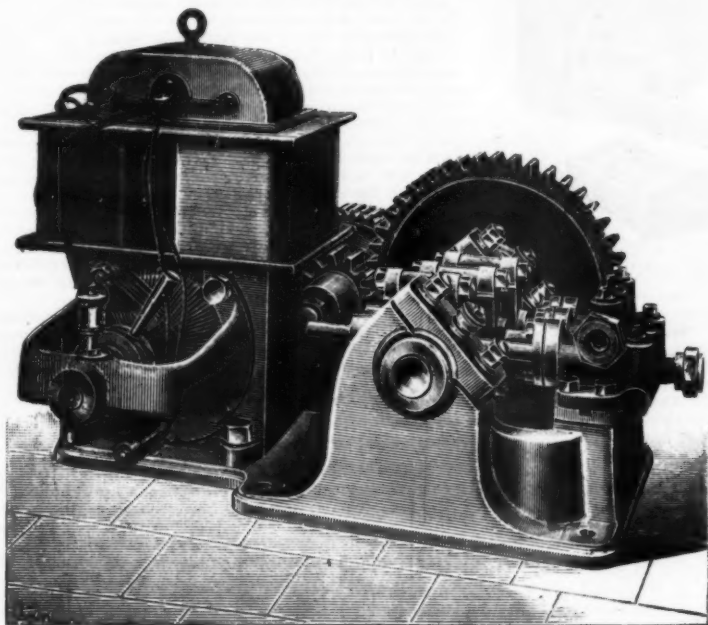
Five sets of hydraulic pumps have been provided in all; four sets are similar to that above, and consist of 3-throw hydraulic pumps with rams  $1\frac{1}{2}$  in. diameter by 4 in. stroke, arranged to run at a speed of 100 revolutions per minute, driven by an electric motor of 10 effective horse power. On reference to the engraving it will be noted the baseplate forms the tank, which holds sufficient water for filling the hydraulic cylinders, the water being run back into the tank through a waste pipe and used over again. The worm gear con-



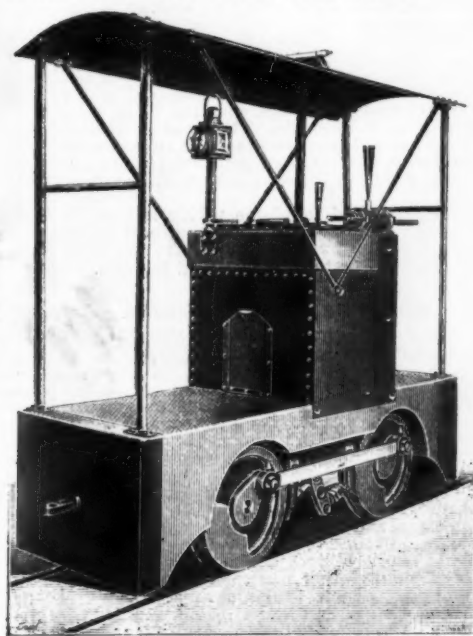
STANDARD DYNAMO.



TEN H. P. THREE-THROW HYDRAULIC PUMP.



THREE-THROW SIX H. P. PUMP.



ELECTRIC LOCOMOTIVE.

minute, 3.6 E. H. P.; planing oak, cut  $\frac{1}{8}$  in. deep,  $6\frac{1}{2}$  in. wide, 11 ft. per minute, 3.6 E. H. P.

Boring machine, speed of bit, 375 revolutions per minute; hand feed; motor belted to bit shaft. Motor, idle, 0.96 E. H. P.; driving machine, idle, 1.7 E. H. P.; boring 4 in. hole in seasoned oak,  $9\frac{1}{2}$  ft. per minute, 2.3 E. H. P.

Boring machine, belt pulley, 8 in. diameter, 3 in. face; speed, 750 revolutions per minute; hand feed; motor belted to machine shaft. Motor, idle, 0.96 E. H. P.; driving machine, idle, 1.9 E. H. P.; boring 1 in. hole in oak, feed,  $3\frac{1}{4}$  in. in 5 seconds, 2.2 E. H. P.; boring  $1\frac{1}{2}$  in. hole in oak, feed 1 in. in 7 seconds, 2.2 E. H. P.

Pattern makers' lathe, speed, 888 revolutions per minute; motor belted direct to lathe. Motor, idle, 0.96 E. H. P.; driving lathe, idle, 2 E. H. P.; turning seasoned poplar, 13 in. diameter,  $\frac{1}{4}$  in. cut, 3.2 E. H. P.

Carver and moulder, speed of tool, 5,236 revolutions per minute; motor belted direct to tool shaft. Motor, idle, 0.96 E. H. P.; driving tool, idle, 2.3 E. H. P.; cutting groove, circular sector, 2 in. wide,  $\frac{1}{4}$  in. deep,  $3\frac{1}{2}$  ft. per minute, in white pine, 3.9 E. H. P.

opposite. A special oiling arrangement is provided, consisting of a pump worked from the eccentric rod, and arranged to deliver oil through all bearings under pressure. Suitable doors are provided for the examination of the engine while running or for adjusting brasses. All the bearings are lined with white anti-friction metal, and the bearing surfaces throughout are very large. The speed of each engine is controlled by a governor attached to a crankshaft working on to an equilibrium throttle valve, and suitable means are provided so that the speed of the engine can be adjusted while running.

Six dynamos in all are provided, these being used for working the electric locomotives, hydraulic pumps for the shields, and also for lighting purposes. The dynamos are fitted with Gramme armatures, each machine being constructed to give an output of 100 amperes and 200 volts when running at a speed of approximately 700 revolutions per minute. The machines are compound wound, self-regulating, and are fitted with adjustable bearings. On reference to the illustration it will be noticed that the height from the bot-

tom of the bedplate to the center of the armature spindle is kept as low as possible to avoid all vibration. The dynamos are mounted upon sliding bedplates with tightening screws and brackets, enabling the slack of the belt to be taken up while running.

Six electric locomotives in all have been provided, the locomotives being in accordance with our engraving. The locomotive frame is of cast iron, and carries the electric motor, which is of 25 effective horse power, this power being provided to enable the locomotives to run at a high speed up to 1 in 30 incline. The electric motors drive through machine cut worm gear, the worm being of steel and the worm wheel of phosphor bronze treble threaded and running in an oil bath. The worm wheel is mounted on one of the crank axles, and the axles are coupled together by connecting rods. Each locomotive is complete with over-

head collecting gear for collecting the current from the overhead copper conductor, also stopping, starting, and reversing switches. On each of the electric locomotives are fitted electric bells and horns.

The electric lighting of the tunnels and surface work is very complete; 16 candle power 300 volt incandescent lamps are used, the lamps being placed in wire protection guards, and suspended from the roof or otherwise as found most convenient. The use of electricity has been found of very great advantage in connection with this contract on account of the much purer atmosphere.—The Engineer.

#### WIRE BUILDINGS FOR TELEPHONES.

By HERBERT LAWS WEBB.

EVERY large office building that is put up to-day should be fully wired for telephone service. Telephone communication is almost as much of a business necessity to-day as ink and paper, and no modern building can be quite modern, and thoroughly up to date, in which provision is not made for supplying telephone communication to every room. At present, it is true, it is rather the exception to find an office building properly wired throughout for telephone connections, but in a few years the exceptions will be those that are not so wired. The demand for telephone service of all kinds is increasing so rapidly that owners of buildings cannot afford to expose their tenants to the delays and inconveniences incident to running wires through large buildings every time a new telephone service is required. A well designed substantial system of telephone wiring is therefore a necessity in the modern office building, in the modern hotel, in the modern factory and even in the modern club or large residence. The architect who would keep abreast with the requirements of the day cannot afford to neglect this.

There are three requisites that a system of interior wiring should fulfill. These are: 1, that the wires should be suitable for telephone working; 2, that they should be accessible to allow of additions, withdrawals or repairs; 3, that they should all terminate at one central point.

The requirements of clause 1 are not difficult to meet. They demand that every circuit shall be metallic and that the two sides of the circuit shall be twisted together with not less than four twists to the foot. This arrangement of the circuit tends to neutralize the disturbing effects of currents that may be circulating in neighboring wires. As to the size of wire, No. 10 B. & S., insulated to  $\frac{1}{16}$  with a good quality of waterproof compound, is sufficiently substantial. But let it be a good quality; beware of cheap insulated wire, for it is the dearest in the end. It is a good plan to have the two wires of the twisted pair of different colors, so that they may be readily distinguished at the ends without the delay of testing out.

Clause 2 means, of course, that the wires should be run in conduits or tubing. The era of inflexible and inaccessible systems of wiring has passed. Every kind of wiring that is done on a large scale should be arranged so that the wires can readily be got at for inspection or repairs, readily withdrawn or added to without disturbing walls, partitions or flooring. Such accessibility and flexibility can only be secured by the use of conduit tubing.

The concentration of all the different circuits at one point is a sufficiently obvious necessity to need no elaboration. The wires should all be taken to a terminal or cross connecting board by means of which connection may readily be made with the trunk lines from the telephone exchange. The cross connecting board will also serve to connect together circuits from different rooms in the event of permanent communication being required between offices in the same building.

A complete system of telephone wiring laid out in accordance with the general requisites outlined above is a very important and valuable adjunct to the modern office building.—Architects' Electrical Bulletin.

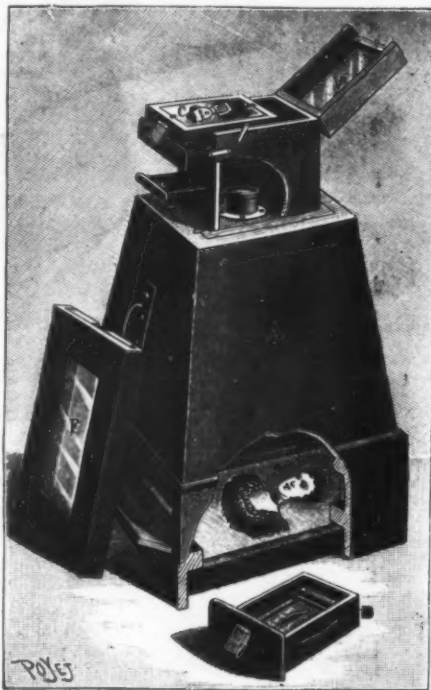
#### SUBURBAN RAILWAY STATIONS.

THE contrast between Boston's and Philadelphia's artistic suburban railway stations and approaches and the things which do duty as such along most of the lines leading out of New York is as striking as mortifying to the residents of the metropolis. The movement of population at the larger cities is to the neighboring towns, no better illustration of which is found than in the ebb and flow of the tide of nearly 200,000 commuters into and out of New York City daily. Neither Boston, Philadelphia nor Chicago, with incoming and outgoing business populations, compares with New York in the extent to which it attracts commercial, industrial and financial pilgrims daily, yet New York, relatively and absolutely, is worse off than the first two, and hardly any better off than Chicago, as to attractive railway stations at nearby points. There is some attempt by the New York Central and New England lines leading out of New York to beautify suburban railway stations and their surroundings, and across the Hudson the New Jersey Central is conspicuous for the success of its efforts in this direction. The Pennsylvania Railway's artistic railway stations and attractive approaches in the vicinity of Philadelphia have helped to give that company the enviable international reputation it enjoys. In the immediate neighborhood of Jersey City the Pennsylvania has less opportunity to encourage suburban development by beautiful stations in the midst of wide-stretching greenlands and winding driveways than most of the roads running out of Jersey City. Among those from which much is expected, the Delaware, Lackawanna & Western is the most conspicuous offender. Even the Erie, of which much is seldom expected, is building a worthy structure for its patrons at Passaic, and is soon to put up adequate stations at Paterson. But the Lackawanna prefers, apparently, to cling to the unclean shed which constitutes its station at Newark, and its incongruous buildings and unsightly surroundings at Summit and at Morristown and elsewhere along the line. The hard-headed financiers who hold the destinies of the Lackawanna in their hands may be blind to the fact that the expenditure of \$100,000 for a new station and the removal of unsightly buildings near it at Summit would increase the value of its own and the town's

property many times that amount, and they are undoubtedly oblivious to the fact that an expenditure of enough money at Morristown to create an artistic railway station and in acquiring and improving adjacent property, so as to attract instead of disgusting a new arrival, would redound to the financial gain of the railway as well as of Morristown. But the burden of effort in this direction is not to be thrown upon the railroad company alone. If the residents of the suburban centers referred to do not take enough interest in securing handsome railway stations and approaches thereto, to hold public meetings and use every proper endeavor to secure such advantages, then that public is itself at fault. One would naturally suppose that a railway company, like the lawyer or the merchant, would seek to retain as well as to attract the client, customer or patron, but such a supposition is manifestly absurd with reference to the Lackawanna, which would seem to have searched high and low for all that is unsightly and repellent with which to surround their suburban railway stations or to remodel and utilize as railway stations.—Bradstreet's.

#### JOUX'S PHOTOGRAPHIC AMPLIFIER.

THE enlarging of a negative is, upon the whole, quite a simple matter, although the operation requires an installation and apparatus devised for the purpose. If a projection lantern be employed, it will be necessary to have a special model that allows no white light to pass, and also to use a condenser that permits of illuminating the negative very uniformly. This is one of the principal difficulties in the work of enlarging by artificial light, the negative to be enlarged being often more strongly illuminated in the center than at the edges. This does not happen with a good apparatus—one that is perfectly adapted to the size of the negative that it is desired to enlarge; but it frequently happens that the operator has a tendency to somewhat force the instrument that he employs, and an apparatus constructed for a  $3 \times 3\frac{1}{2}$  in. negative is sometimes used for



PHOTOGRAPHIC AMPLIFIER.

a  $3\frac{1}{2} \times 5$  in. one. In this case the results will be defective. From this point of view, the use of daylight is preferable. The installation will made for all sizes of negatives, the illumination is always uniform. On another hand, it is impossible to work at night, and the time of exposure must be varied not only according to the density of the negative, but also according to the state of the sky.

Every medal has its reverse; but, however this may be, it is daylight that has been judged the most practical by manufacturers of small apparatus, and so they have devised special instruments of easy manipulation that permit of operating almost automatically.

We have already described several of these, and now purpose to make known the one manufactured by M. Joux, the maker of the "steno-jumelle."

His apparatus consists of a truncated pyramid, A, upon which is fixed an objective. To the top is adapted a box, B, closed by a cover, V, provided with a ground glass, and which we have here supposed to be open. Just above the objective there is a shutter that slides into the box with slight friction. At the upper part of the box and beneath the cover there is a slide that permits of inserting the frame, C, carrying the negative to be enlarged. This frame has two grooves, which are situated at such a distance from each other that the negative is in focus for a magnification of  $5 \times 7$  in. when the slide most distant from the objective is used, and of  $7 \times 9\frac{1}{2}$  in. when the nearest is employed. At the base of the box, A, there are two apertures designed to receive a frame with a curtain into which is put the sensitized paper that is to receive the enlarged image. The aperture most distant from the objective is used for dimensions of  $7 \times 9\frac{1}{2}$  in. and the nearest for those of  $5 \times 7$  in.

The modus operandi is very simple. After the size of the enlargement that it is desired to obtain has been chosen, and a sheet of sensitized paper has been placed against the glass of the frame, in a dark room, the frame is closed and introduced into the apparatus. On another hand, the negative is arranged at the other extremity, as we have already explained. After this, the cover that carries the ground glass and is designed to filter the light and to diffuse it is closed, the curtain of the frame is drawn aside, and the shutter is pulled

out. There is nothing to be done now but to point the apparatus toward the sky for a few minutes—from one to ten, according to the negative, the weather and the paper employed. The developing and fixing are done as usual.

The same apparatus may, of course, be used reversibly, that is to say, be made to give small positive images from large negatives. In this case, there are used two frames, D and E, which are represented apart in our engraving.

The small frame, D, has a curtain, and in it (in the laboratory) is placed the sensitized plate that is to receive the positive image designed to be projected. In the frame, E, which is provided with a ground glass, is arranged the  $5 \times 7$  or  $7 \times 9\frac{1}{2}$  negative that is to be reduced. Then each frame is put in place in the apparatus, the apertures into which it is inserted depending, as before, upon the dimensions to be obtained.

After the curtain of the small frame has been drawn aside and the shutter has been pulled out, the large end of the apparatus is turned skyward for a few minutes.

A preliminary experiment is necessary to determine the time of exposure.—La Nature.

#### SOME NOVEL USES FOR ARTIFICIAL REFRIGERATION.

NUMEROUS special applications of refrigeration have arisen which would scarcely have been suspected until small refrigerating plants were perfected. There are many products, such as oil and chemicals, which are drawn very hot from the stills and retorts, and on which the saving of time by quick cooling more than pays for the cost of refrigeration.

Among these lines of service perhaps one of the most interesting is that of chocolate making. Chocolate was formerly manufactured only in cold weather, when the temperature was low enough for it to be worked and hardened.

A working room temperature of  $65^\circ$  is sufficient for the dipping process and insures the setting of the chocolate when put in the chill room at  $45^\circ$ . If the temperature be much above  $65^\circ$  the chocolate remains sticky and plastic, which is very inconvenient under any circumstances, and absolutely fatal to bonbons.

Cooling coils are placed around the room like steam pipes, but, in addition to this, and of even greater importance, air bunkers are provided, containing ammonia coils, over which the air is forced and cooled. It is then delivered to the room through large galvanized pipes, running across the ceiling, thus providing ventilation for the operatives and the requisite coolness to work the chocolate. The chill room is refrigerated to  $45^\circ$  in the usual way, and opens off the dipping room.

Another one of the many odd uses of refrigeration is in connection with gelatine working. Every one is familiar with the gelatine capsules in which medicine is administered, and will readily understand that difficulty might be experienced in manufacturing such articles in hot and moist weather.

The capsules are formed of sheets of gelatine pressed over steel pins. The cooling must take place rapidly, in order to turn out the product in sufficient quantity, while to insure quality and general evenness of material a proper temperature must be provided.

In one of these instances it was found that about 120,000 cubic feet of air had to be cooled per hour in order to insure an even temperature for the gelatine, and about 160,000 pounds of steel pins per working day had to be cooled from about  $90^\circ$  to  $75^\circ$ . By combining the two requirements and making the blast of cold air cool the pins, both of these results were effected through one operation, requiring only the cooling of sufficient air in bunkers with refrigerating coils. Perfect success was met, and probably in no other way could so useful a result have been obtained so cheaply.

In the tempering of steel or the cooling of other articles in a bath of special composition of such sort that it cannot well be run to waste—as oil or brine—the necessity arises of removing the heat surrendered by the material cooled, thus keeping a constant temperature in the dipping tank.

In the case of saw tempering, a large volume of brine is refrigerated and circulated through the dipping vat. The large reserve volume acts as a fly wheel, equalizing fluctuations of temperature arising from varying rates of dipping, the compressor running continuously.—W. C. Kerr, in Cassier's Magazine.

#### AREAS OF DISEASE.

IT is a common knowledge that diseases have, as a rule, their local habitations, says the London Saturday Review. Some, like tropical animals and plants, live only in the tropics; some, like consumption, are gradually spreading over the whole earth; others, like leprosy and smallpox, are gradually becoming limited in their distribution, and may actually be tending toward extinction. Again, there are regions to which diseases have never reached. On the summits of high mountain ranges and in the circumpolar snowfields the earth and air and water are as barren of the microbes of disease as they are of animal life. Without question, if Nansen and his companion had been exposed to the same hardships and the same unsanitary conditions in these islands, the lowered vitality of their bodies certainly would have been unable to resist the continual bombardment of germs to which we are all subjected. In a country like Britain, thickly populated for many centuries, and with the freest circulation of population, it cannot be doubted that every yard of surface contains the germs of the more common diseases, and the native of some newer land, brought over here, falls a victim to our plague-stricken soil. By generations of a destructive elimination we have become highly resistant to our native diseases, just as the Gold Coast natives are less susceptible than we are to their own local diseases. But we are not fully protected, and cancer and consumption—two of our common scourges—still take a large annual toll. It may be assumed that both are due to micro-organisms, the microbe of consumption being well known, that of cancer being as yet only suspected. Probably no inhabitant of Britain escapes infection by the cancer organism; certainly none escape infection by the microbe of tubercle. Most of us, fortunately, resist the intruders and are unaffected by the disease.

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## ELECTRICAL NOTES.

**The London Electrical Review** has this announcement: "Appointment Vacant.—The Morecambe District Council is inviting applications for the post of resident electrical engineer at £175 (about \$875) per annum." This is about the wages of an able bodied hod carrier in the United States.

According to a German authority, turbid beer can be clarified by electric light. It is said that if electric lamps are suspended in the fermenting vessels, the yeast matters are rapidly deposited with the resinous, albuminous, and glutinous substances that are always present. The result is due to the light itself, not to the change in temperature.

During the convention of the Nobles of the Mystic Shrine held in Detroit, June 7 to 10, what was probably the largest trolley party in the world was made up of the visitors. Sixty-seven open cars were used and 3,950 people took in the ride, the route being around the city and ending at the Water Works Park. The cars were gayly decorated with flags, and the conductors and motormen each wore a boutonniere. Not a hitch marred the trip. The affair was managed by Messrs. A. A. Schantz, G. P. A. of the Detroit and Cleveland Steam Navigation Company.

Berlin now possesses an electrically driven underground railway, says the Electrician. A tunnel 380 yards long and 3 ft. 4 in. below the level of the street has been made by the Allgemeiner Electricitäts-Gesellschaft to connect their two factories in Brunnen Strasse and Acker Strasse. There are two curves of 50 ft. and 80 ft. radius respectively, and a gradient at one end of the line of 1 in 15. The line is of normal gage and single track. The overhead system is used for conveying current to the locomotives. The latter have two motors, and are designed to draw 10 tons.

The American Machinist extracts from a contemporary a gamut of speeds per second, beginning with that of the snail, which is half an inch, and ending with the following: "Electric current on telegraph wires, 7,000 miles; induction current, 11,040 miles; electric current in copper wire armatures, 21,000 miles; light, 180,000 miles; discharge of a Leyden bottle through copper wire 1-16 inch in diameter, 277,100 miles. This last is the greatest rapidity so far measured." These figures might have more weight and more interest if the methods of calculating them or the authorities had also been given.

The flexibility of the electric elevator machine has recently been most strikingly illustrated at one of New York's newest skyscrapers, now being erected in the lower part of the city. Three electric elevators were installed and put in operation while the building was in the very early stages of construction, this being made possible by securing the current from the street lighting system. Rough cages were first operated, serving as hoists for building material and for the various mechanics. Not only has a great deal of time been saved by the early installation of the elevator apparatus, but so efficient has the freight service been that the hod carriers' work has been largely dispensed with, resulting in a saving of money, but, according to the Electrical World, at the same time bringing forth a strong objection from the Hod Carriers' Union.

Koch, in the Elek. Zeit., thinks it will suffice to run ordinary galvanized iron wires around the top and edges of a house, say in the form of about ten wires, each leading into the ground, to protect it from lightning. If telephone or other wires or gas or water pipes enter the house, they should be connected with this system of lightning wires through suitable arresters when necessary. The platinum or gold points he considers unnecessary. Precht has shown that the issuing of electricity from points takes place so slowly that the points cannot respond to the rapid oscillations of the lightning discharge. The wires may be secured directly to the building; as iron rusts when soldered, all soldered joints should be avoided and the wires should be run in continuous lengths into the ground. The earth connections may be made by simply running short pieces of wires into the ground. The cost of such a system for an ordinary house should not exceed \$4 to \$5.—Elec. World.

A table taken from the annual reports of the railroad commissioners of Massachusetts and New York for nearly all of the street railway properties shows some interesting facts, says the Engineering and Mining Journal. The table gives the number of cars owned, the car mileage per year, and the cost of the electric power per car mile and per passenger. Of the 19 companies operating less than 250,000 car miles, 4 are obtaining power at a cost of less than 2c. per car mile, 6 between 2 and 3c., 5 between 3 and 4c., 1 between 4 and 5c., and 3 at more than 5c.; of the 5 companies operating over 5,000,000 car miles per year, 1 obtains the power for less than 1c. per car mile, 3 between 2 and 1c., and 1 between 2 and 3c.; other similar figures are also given between these limits. The Brooklyn Heights Company has the cheapest power, 0.86c. per car mile, followed by the Binghamton with 0.94c.; the cost of power for the Massachusetts roads includes repairs and depreciation of the station plant, which is not the case for the New York roads.

In a recent article in the American Machinist, Mr. A. M. Lozier, M.E., of the Bullock Electric Manufacturing Company, says: "When electrical transmission stepped to the fore, even the best equipped factories presented a most inconsistent appearance. Their condition might be compared to two strong iron links of a chain held together by a piece of string, for on the one hand their boilers and engines were of the best and most economical types, and on the other hand their tools or printing presses were compact, automatic and highly efficient. But the connecting link, the means of transmitting the power from the engine to the tool, was a weak one, a great source of waste in power and a relic of conservatism. It is astounding that for years, thousands (indeed, one may say millions) of horse power hours have been wasted in the mere friction load of shafting and belting, without any serious consideration of the matter by mill owners and printers. Records of tests made in over 200 representative factories and printing establishments of this country alone show, as an average, that about 50 per cent. of all the power generated by the engines has been wasted in belt or rope transmission of power."

## MISCELLANEOUS NOTES.

**Johannesburg**, according to the latest figures, has now 136,000 inhabitants, 51,000 of whom are whites. There are 16,265 British, 3,335 Russians, 2,263 Germans, 819 Dutch, 442 Frenchmen, 311 Swedes and Norwegians, 206 Italians, and 648 from other non-African countries; the others come from the Orange Free State and the British South African colonies.

The use of liquid fuel is extending in the mines and mills of the Oural region. It has recently been adopted by the Ust-Katovski Iron Works, and in the iron works at Zlatoust. At the Miniarski Works, in the Szimski district, oil is now used for heating the puddling furnaces, and for all purposes except in the blast furnace, where charcoal is used.

When the Estienne School was opened in Paris last year Le Figaro discovered the last male descendant of the great family of printers, a printer as all his forefathers had been, and regretted that the name must die, as he had a family of daughters only. M. Estienne is now the father of a boy, whom he has named Robert, who will be a printer, too, when he grows up.

Russia's imperial appanages constituting the domain reserved for the support of the younger branches of the imperial family, which was begun by Emperor Paul I, now comprise 21,000,000 acres with a revenue of \$10,000,000 a year. The Department of Appanages is the largest land owner, farmer and wine producer in the empire, and is developing timber, sugar and cotton industries on a very large scale. It is distinct from the private possessions of the Romanoffs and from the state or crown demesnes.

The London Chronicle says: "Between March, 1895, and March, 1897, 187,283 men were dispatched to Cuba, 4,827 to Porto Rico, and 26,622 to the Philippines, making a grand total of 218,731. The losses in Cuba from wounds and disease are set down at over 47,000 men, without counting some 16,000 in hospitals. Statistics are not fully returned from the Philippines, but the absence of yellow fever reduces the rate of mortality. The cost of the Cuban war may be roughly estimated at not less than \$45,000,000. In the Philippines the expenses mount up to about \$400,000 a month. Apart from this burden the nation has had to pay 78,000,000 pesetas in the shape of substitution money for recruits who have shirked the unpleasant duty of serving abroad. Few of the youths sent home from either seat of war will ever regain sound health, as they joined the ranks too early."

Some French lawyers are trying the experiment of giving legal advice free at the Palais de Justice, on the same principle as medicine is dealt out at dispensaries. The idea is a revival of the Bureau of Charitable Jurisprudence, planned by the Constituent Assembly in 1790, and it has been in operation for nearly two years. There are several departments, each managed by a lawyer of ten years' standing, with two younger men as his assistants. The office is open one morning and one afternoon a week. Last year, from January to December, 1,964 persons applied for advice; 1,600 of them merely wanted answers to some legal questions, 17 were lunatics, and 37 well-to-do people were seeking assistance under false pretenses. The lawyers took up, however, 106 delicate and complicated cases and succeeded in settling 61 of them to the satisfaction of their clients; the other 105 were lost after a trial.

"The value of the pearls found during 1896 on the coast of the gulf of Lower California," says Handels-Museum, "amounted to \$350,000. Besides, there were, however, also exported 5,000 tons of mussel shells, the value of which was estimated at a further \$1,250,000. The pearl fishing with appurtenances forms the entire occupation of the natives, and La Paz, the capital for this trade in the peninsula, exists exclusively upon this industry. Until a few years ago only native divers had been employed, and the greatest depth to which they could dive was thirty-five feet. Upon the introduction of the modern diving apparatus a depth of 180 feet was accomplished, and while formerly the best divers could not remain longer than two minutes under water, a modern diver thinks nothing of staying for two hours at a depth of 100 feet, although at a still greater depth the stay is necessarily shortened on account of the enormous volume of water above. The pearl fishing is mostly a matter of good luck, and this is the great charm which attracts the natives, who are almost without exception born gamblers. It is known that not every oyster contains a pearl, and a really valuable one is only now and then met with. Most of the pearls which are found in the waters of Lower California are so-called seed pearls of a very modest value. The divers do not limit themselves to the pearl oysters, but whenever they come across a rare piece of coral or a new kind of mussel they pocket these likewise."

The gold mines of Cañada Honda are the best known of those in the hill range of the province of San Luis, according to a recent article in the Berg- und Hütten-männische Zeitung. The gold found at Cañada Honda occurs in a comparatively limited area in the valley of that name, and is formed of the detritus of the gold-bearing quartz from the vicinity of the andesite formation, the metal having been washed down as far as Villa Mercedes, leaving the chief deposits of the denuded material near the original site. The workable deposit has a maximum length of 2,200 ft. by 300 ft. in width, and is covered to a depth of about 30 ft. by a barren layer of black earth, followed by a yellow sandy loam. The gold-bearing deposit (Llampos) contains gneiss, crystalline shale, quartzite and andesite, along with a yellow interstitial loam, and has a depth of about 5 ft. A number of depressions, wherein gold has collected, are met with on the surface of the bed-rock, and the latter frequently contains gold to a depth of about 1 ft., probably as a result of mechanical agency rather than segregation. The water supply for sluicing is very irregular, there being a scarcity in the winter and frequently a superabundance in the summer season. In winter the chief work is that of washing the deposit exposed by the summer sluicings, and this is effected by three sluices 30 ft. long, 13 in. wide and 8 in. deep, divided into two parts, the lower portion containing the riffles. Four men and a boy are required for working each sluice, and the average daily recovery of gold is  $\frac{1}{2}$  to  $\frac{3}{4}$  oz. per sluice.

## SELECTED FORMULÆ.

**Colors for Polished Brass.**—Mr. E. Ebermeyer has just published in the Zeitschrift für der Chemie Indust. formulas for a number of baths, designed to give polished brass various colors. The brass objects are put into boiling solutions composed of different salts, and the intensity of the shade obtained is dependent upon the duration of the immersion. With a solution composed of:

Sulphate of copper..... 120 grains.  
Hydrochlorate of ammonia..... 30 "  
Water..... 1 quart.

greenish shades are obtained. With the following solution, all the shades of brown from orange brown to cinnamon are obtained:

Chlorate of potash..... 150 grains.  
Sulphate of copper..... 150 "  
Water..... 1 quart.

The following solution gives the brass first a rosy tint and then colors it violet and blue:

Sulphate of copper..... 435 grains.  
Hyposulphite of soda..... 300 "  
Cream of tartar..... 150 "  
Water..... 1 pint.

Upon adding to the last solution:

Ammoniacal sulph. of iron..... 300 grains.  
Hyposulphite of soda..... 300 "

there are obtained, according to the duration of the immersion, yellowish, orange, rosy, then bluish shades. Upon polarizing the ebullition, the blue tint gives way to yellow, and finally to a pretty gray. Silver, under the same circumstances, becomes very beautifully colored. After a long ebullition in the following solution, we obtain a yellow brown shade, and then a remarkable fire red:

Chlorate of potash..... 75 grains.  
Carbonate of nickel..... 30 "  
Salt of nickel..... 75 "  
Water..... 10 ounces.

The following solution gives a beautiful dark brown color:

Chlorate of potash..... 75 grains.  
Salt of nickel..... 150 "  
Water..... 10 ounces.

The following gives, in the first place, a red, which passes to blue, then to pale lilac, and finally to white:

Orpiment..... 75 grains.  
Crystallized sal soda..... 150 "  
Water..... 10 ounces.

The following gives a yellow brown:

Salt of nickel..... 75 grains.  
Sulphate of copper..... 75 "  
Chlorate of potash..... 75 "  
Water..... 10 ounces.

On mixing the following solutions, sulphur separates and the brass becomes covered with iridescent crystallizations:

1. Cream of tartar..... 75 grains.  
Sulphate of copper..... 75 "  
Water..... 10 ounces.  
2. Hyposulphite of soda..... 225 grains.  
Water..... 5 ounces.

Upon leaving the brass objects immersed in the following mixture, contained in corked vessels, they at length acquire a very beautiful blue color:

Hepar of sulphur..... 15 grains.  
Ammonia..... 75 "  
Water..... 4 ounces.

## Photographic Hints and Formulas.—

From Liesegang's Photographischer Almanach.—(Amer. Photo. J.)

A New Developer for Transparency and Lantern Plates:

Water..... 60 ounces.  
Sulphite of soda (crystals)..... 60 "  
Metol..... 1 "  
Bicarbonate of soda..... 3 "  
Bromide of potassium solution (10 per cent.) a few drops if necessary.

Dissolve in the given rotation.

Clearness is the first requisite in a good lantern slide, while in a transparency for decorative purposes a slight veiling of the high lights is not objectionable.

Toning and Fixing Baths for Artistic Types:

Plain Bath—

Water..... 32 ounces.  
Pure gold.....  $\frac{1}{2}$  gr.

Acetate Soda Bath—

Water..... 24 ounces.  
Acetate of soda, saturated solution.....  $\frac{1}{2}$  "  
Gold enough to tone.

Phosphate Soda Bath—

Water..... 28 ounces.  
Phosphate soda.....  $\frac{1}{2}$  "  
Gold enough to tone.

Neutralize with bicarbonate of soda or borax. Bath should be as near neutral as possible, or but slightly alkaline. If toning should proceed faster than five minutes, dilute with water. Use strong bath for cold tones and a weak one for warm tones.

Do not overtone; some red should be left in the shadows. When toned put them in running water or—

Salt..... 4 ounces.  
Water..... 1 gall.

Wash in a couple of changes of fresh water before fixing.

Fixing Bath—

Cold water..... 1 gall.  
Hyposulphite of soda..... 6½ ounces.

Fix ten to fifteen minutes. Never use the same twice.

Should a harder surface be desired, add, after pictures have been in the bath ten minutes, from 3 to 6 ounces of the following solution:

Alum..... 1 ounce.  
Water..... 12 "

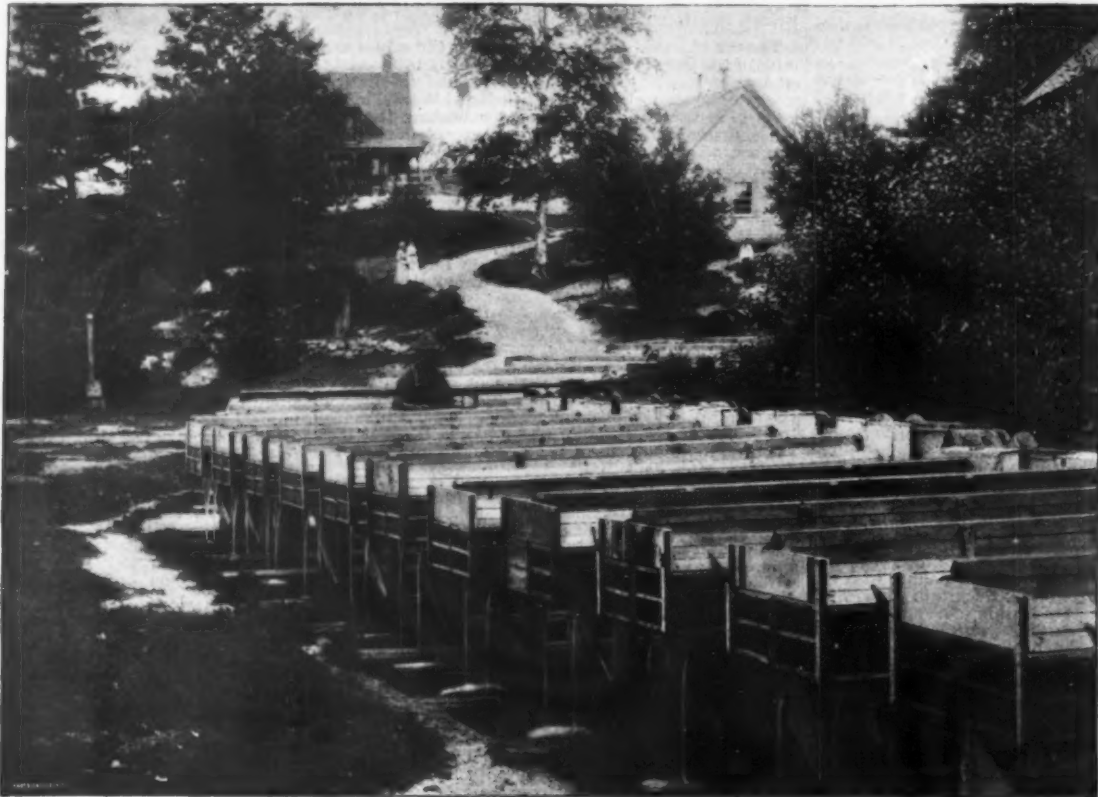
Fixing bath should be cold.

THE PROPAGATION AND DISTRIBUTION OF FOOD FISHES.

THE report of the United States Commissioner of Fish and Fisheries for the fiscal year ending June 30, 1896, contains some interesting particulars regarding

very satisfactory, 148,000,000 shad, 105,000,000 lobster and 31,000,000 tautog eggs being secured. The scarcity of mackerel made it desirable that the government should endeavor to increase the supply of this valuable fish, and steps were taken in April to engage in the propagation of the species at various points on the

There have been distributed in suitable public and private waters, by means of the cars and messengers of the commission, 498,488,268 eggs, fry, yearlings and adults of various fishes. The output of some of the more important species, which is markedly in excess of the previous year, is as follows :



SALMON REARING TROUGHS, CRAIG BROOK STATION, ME.

the propagation and distribution of food fishes in the United States. When the present commissioner assumed charge, especial attention was at once directed to increasing the supply of the commercial fishes of the ocean and inland waters, and the propagation and rearing of certain coarser species was discontinued in order to increase the output of more important ones. The principal fish cultural work in hand was the propagation of shad, and the available force was concentrated at the shad hatching stations at Bryan Park, on the Potomac River, and Battery Island, on the Susquehanna River. Work on the New England coast followed, and the usual provisions were made for collecting lobster eggs at Wood's Hole and Gloucester, Mass. The steamer Fish Hawk was also engaged in shad hatching on the Delaware and afterward in collecting lobster and mackerel eggs on the Maine coast, where she was assisted by the schooner Grampus. The result as compared with the preceding year was

New England coast. About 24,000,000 eggs were obtained.

The following stations were operated during the year:

Craig Brook, Me.	Fish Ponds, Washington, D. C.
Green Lake, Me.	Wytheville, Va.
St. Johnsbury, Vt.	Put-in Bay, Ohio.
Gloucester, Mass.	Northville, Mich.
Wood's Hole, Mass.	Alpena, Mich.
Cape Vincent, N. Y.	Duluth, Minn.
Delaware River (steamer Fish Hawk).	Quincy, Ill.
Battery Island, Md.	Neosho, Mo.
Bryan Point, Md.	Leadville, Col.
Central Station, Washington, D. C.	Baird, Cal.
	Fort Gaston, Cal.
	Clackamas, Ore.

Shad .....	93,481,500
Salmon .....	10,845,852
Lake trout .....	8,996,618
Whitefish .....	189,740,000
Cod .....	66,212,000
Flatfish .....	8,472,000
Lobster .....	97,079,000

Plants were made in all the States and Territories, and eggs of various species were sent to representatives of foreign governments and fish cultural societies in return for similar courtesies received from them as follows :

Quinnat salmon.....	95,000
Steelhead trout .....	75,000
Rainbow trout.....	125,000
Lake trout.....	50,000
Whitefish.....	50,000
Total .....	395,000

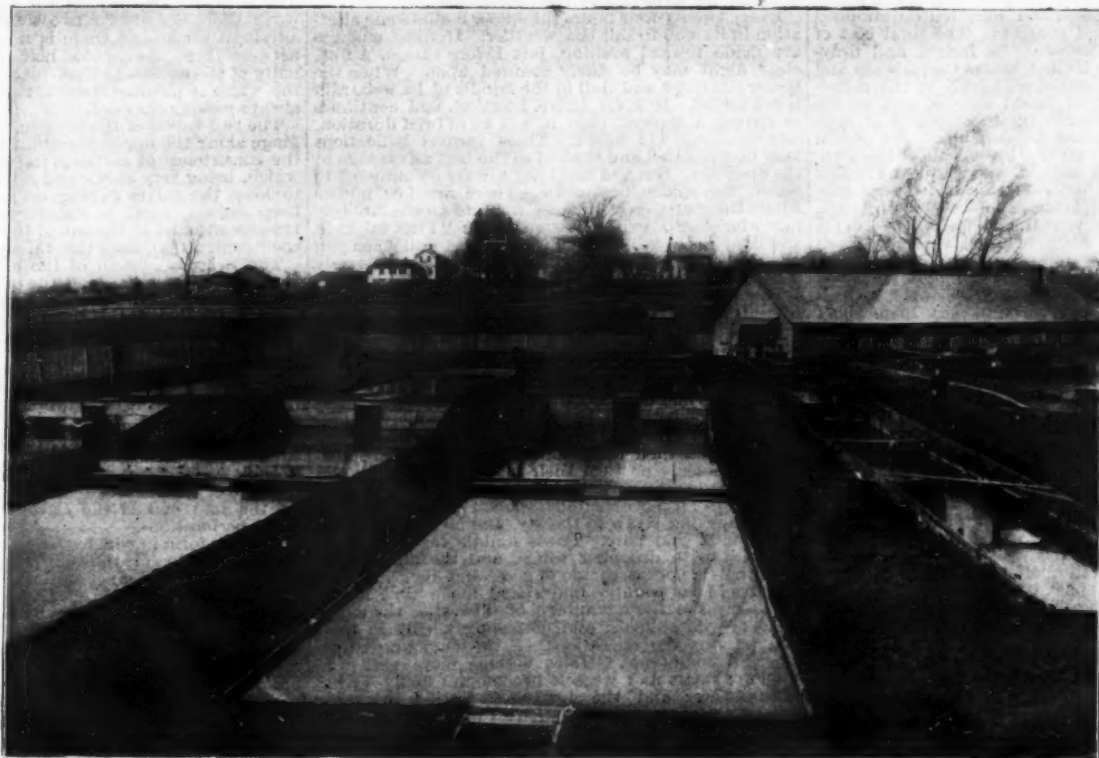


FISH REARING PONDS, CRAIG BROOK STATION, ME.

Further experiments have been made in weaving artificial nests in spawning black bass at Wytheville, the fish ponds at Washington and at Put-in Bay. From the results secured at the former station it is believed that artificial nests may be successfully used and the problem of raising this species simplified. In accord-

about 76,631,000 pounds of fish and salt fish, valued at \$2,305,600; at Boston the quantity of fish landed aggregated 73,806,000 pounds, having a value of \$1,346,000. The combined receipts were thus 150,437,000 pounds, valued at \$3,551,600. As compared with the previous year there was a net decrease in the quantity

The fur seal investigations for 1896 provided for a scientific investigation into the present condition of the fur seal herds in the Pribilof, Commander and Kurile Islands. Dr. David S. Jordan was selected to take charge of the party, assisted by Mr. Leonhard Stejneger and Mr. F. A. Lucas, of the United States National



TROUT PONDS, NORTHVILLE, MICH.

ance with previous custom, the use of the laboratory at Wood's Hole was granted to representatives of various colleges for biological study, in order that the commission might be benefited by the results of their researches.

The canvass of the fishing industry of the interior waters of the United States begun in the winter of 1895 was resumed and actively pushed during the entire year and is complete. The inquiry did not cover the great lakes, which were canvassed the previous year, but included all those interior States in which the industry was carried on to any great extent. These fisheries are of considerable economical importance, as in 1894 they employed 11,282 persons, representing a total capital invested of \$722,328, and yielded to fishermen a product valued at \$1,791,145. Inquiries were also prosecuted by local agents at Gloucester and Boston covering a large part of the offshore fishing of New England, which served the purpose of keeping the commission well informed regarding the condition of the great fishing banks of the coasts of New England, Nova Scotia and Newfoundland. At Gloucester there were discharged by American fishing vessels

of fish landed at Gloucester amounting to about 3,000,000 pounds, the falling off being principally in mackerel, halibut, cusk and hake, while the receipts of cod exceeded those of 1894 by 5,430,000 pounds, and of 1893 by 8,781,000 pounds. The fish brought into Boston in 1895 weighed 13,657,000 pounds less than in the previous year, nearly all of the important species showing a decrease.

In the spring of 1896 the investigations of the salmon streams of the Pacific coast were planned with the view to select suitable sites for hatcheries, and at the close of the fiscal year this work had been begun and was actively carried on. In addition to the regular annual investigation of the fur seal rookeries required of the Fish Commission by act of Congress, arrangements were made for special studies during the summer of 1895 of the natural history of the herds on the Pribilof and Commander Islands for purposes of comparison with their condition in former years with reference to the means necessary for their protection. The investigations are described in detail in the exhaustive report of Mr. Stejneger, published in the bulletin of the commission for 1896.

Museum, Lieut. Commander J. F. F. Moser, U. S. N., commander of the steamer Albatross, and Mr. C. H. Townsend and Mr. Joseph Murray, special agent of the Treasury Department, and Mr. G. A. Clark, secretary. The Albatross was detailed by the President to convey the party to Bering Sea, and sailed from Seattle, June 24, with the investigators on board. For a brief description of the trip the reader is referred to the report of the commissioner.

Among other work of the commission were studies of the mackerel fisheries, studies into the condition of the oyster fisheries on the coast of Florida, special investigations as to the extermination of migratory fishes in the Indian River, Florida, etc. The exhibit of the commission at the Cotton States and International Exposition, Atlanta, was considered one of the most attractive features of the Exposition, particularly the aquarium. The commission has continued the practice of turning over to the National Museum collections made by its agents and vessels. The commission also issued a number of bulletins and reports.

Having now described the general work of the commission for the fiscal year ending June 30, 1896, we



SELECTING AND STRIPPING RIPE TROUT, NORTHVILLE, MICH.

will take up some of the interesting hatcheries which are described in the report of the commission.

From this report it appears that there was a distribution of yearling fish from the Craig Brook (Me.) station, consisting of 151,676 Atlantic salmon, 12,235 landlocked salmon, 27,763 brook trout, 10,000 rainbow trout, and 1,376 Scotch sea trout. The fish were cared for during the summer in the troughs and ponds shown in our illustrations, and were fed on chopped beef, butchers' offal and maggots. The total cost of fish food for the year, including its freight and drayage, was \$313.88. The United States Commission and the State of Maine operated conjointly in the collection and maintenance of brood salmon, and in the maintenance and incubation up to shipment of eggs removed to other stations for hatching. To obtain live fish from the weirs about the mouth of the Penobscot, the following method was employed: The fishermen agreeing to furnish live salmon were supplied in advance with large, fine meshed dip nets, lined with flannel to prevent the chafing of the fish; a car was stationed in every neighborhood, and each fisherman whose weirs were so far from the moorings of the car as to forbid their being brought alongside for the direct receipt of captured fish was provided with a large box in which to transport them short distances. As low water approached and before it became low enough to leave the fish stranded on the floor of the box, the salmon were carefully dipped out and placed in the cars. Once a day the collecting steamer made a tour of the district, taking in tow the cars containing salmon and leaving empty ones in their places. The cars were then taken to Dead Brook, where the fish were released in an inclosure of about a third of a mile up and down a sluggish stream, averaging 3 or 4 yards in width and having an extreme depth of about 6 feet. During the season persistent efforts were made to keep the temperature down in the cars by means of ice, and positively favorable results were at last attained by arranging their interiors so that the water, admitted in a greatly reduced volume, should pass through a cooling compartment before reaching the fish. In the application of this method it was necessary to have a separate boat containing a considerable quantity of ice to accompany the fleet. Notwithstanding the fact that every effort was made to protect the salmon from injury in handling, a great many died in a short time from the effects of bruises and chafing. Thirty per cent. may be given as the ordinary ratio of loss out of those liberated in the inclosure.

Egg collections commenced October 26 and closed November 7. The total yield was estimated at 992,000, but a later computation based on careful measurement showed a take of 1,027,353. Of these, 106,653 were lost. The United States received as its portion 602,700 and the State of Maine 318,000. Of those belonging to the station, 329,000 were distributed, and the remainder were reserved for hatching and rearing. Of the 274,158 fry produced from them, 244,405 survived to the close of the year.

In Michigan fish cultural work has been carried on at the Northville station in hatching trout eggs, our illustrations representing the stripping of the fish for eggs and the trout ponds. During the months of July and August the station force was employed as usual in repairing the ponds, improving the grounds and overhauling and repairing the hatching apparatus. The first consignment of lake trout eggs was received on October 27 and the last on December 5, the total collections amounting to 11,122,000, over 3,000,000 in excess of any previous year's take. Owing to the limited capacity of the hatching house it became necessary to ship 5,750,000 of them. Of these eggs, 4,600,000 were shipped in the green stage and 1,150,000 after the eye spots appeared. From those remaining at the station, 1,295,000 fry were hatched and distributed during the months of April and May, plants amounting to 400,000 being made in Lake Huron, 750,000 in Lake Michigan and 100,000 in the Straits of Mackinac. The remaining 45,000 were distributed to private individuals for stocking inland lakes.

For the cultivation of brook trout arrangements were made for the lease of 4 acres of land on a brook flowing into the Au Sable, a field station was established and the collection of fish commenced on August 26. Operations were continued until November 10, during which time 6,453 trout were caught and confined in a pond prepared for them. During the early part of the season the collections were made with rod and line, but after October 1 a seine was used with excellent results, a 20 foot minnow net bringing in at each haul from 5 to 75 trout. The largest catch in any one day was over 600. The first ripe fish were found on October 3, and by the close of the season 386,807 eggs had been secured. From the experience gained this year, there is no doubt that much better results can be secured, and at reduced cost, as it is unnecessary to establish the station before the end of September. A number of experiments were made during the season in transferring eggs before they were eyed from the field stations to Northville. Fourteen shipments of eggs were made, varying in age from 1 to 23 days, and it was found that they could be moved successfully up to and including the eighth day; between the eighth and the eighteenth days the losses were much heavier, in some cases being as high as 50 per cent. The mortality among the wild brook trout taken from the Au Sable early in the summer was very heavy, and only 233,928 eggs were secured from them. From the domesticated stock 46,710 eggs were taken from 78 spawners. Of 667,445 brook trout eggs obtained from all sources during the season, 75,000 were transferred to the United States Fish Commission stations at St. Johnsbury, Cape Vincent and Duluth; 20,000 were furnished to the Minnesota Fish Commission, and 20,000 to applicants in Ohio. From the remaining stock, 210,000 fry were hatched and furnished in March and May to applicants in Michigan, Iowa, Wisconsin and Ohio, for planting in public waters.

#### LIVING BAROMETERS.

The spider is a good example of the living barometer. Close observation of the work on its web castle will soon enable one to forecast the weather. When a high wind or a heavy rain threatens, the spider may be seen taking in sail with great energy—that is, shortening the rope filaments that sustain the web structure. If

the storm is to be unusually severe or of long duration, the ropes are strengthened as well as shortened, the better to resist the onset of the elements. Not until pleasant weather is again close at hand will the ropes be lengthened as before. On the contrary, when you see the spider running out the slender filaments, it is certain that calm, fine weather has set in, whose duration may be measured by their elongation.

Every twenty-four hours the spider makes some alteration in its web to suit the weather. If these changes are made toward evening, just before sunset, a fine, clear night may be safely counted upon. When the spider sits quiet and dull in the middle of its web, rain is not far off. If it be active, however, and continues so during a shower, then it will be of brief duration, and sunshine will follow. These various indications may be witnessed and studied to the best advantage in the open air. But you need not always go outdoors to watch the spider barometer. There are few houses where the crafty creature does not find an obscure corner wherein to swing its signboard: "Flies taken in and done for here." Watch these places, and when you see the spiders coming out on the walls more freely than usual, you may be sure that rain is near.

There are individuals who would not keep a stock of spiders about their premises for the express purpose of prophesying the weather from their movements, and the enmity felt by the good housewife for this particular species of animal is notorious. Those individuals can study the movements of their own domestic animals. Cats and dogs are given to scratching and other uneasy movements on the approach of rainy weather, and their fur looks less bright and glossy. Horses and cattle stretch their necks and sniff the air. Sheep become frolicsome or turn their backs to the wind, and quarrel frequently. Goats bleat incessantly, and leave the hilltops for more sheltered spots. Pigs run uneasily about, carrying straw to the sty, and no longer wallow in the mud and mire. Fowls huddle together in the farmyard with drooping wings, and the air is filled with the clamorous cackle of geese and ducks. Those who live in the country and spend much time in the open air have the advantage of observing the movements of wild animals, and of feeling keenly in their own persons the operations of the changing atmospheric conditions. Moles become more active in digging; stoats and weasels become unusually restless and uneasy; and the hedgehog fortifies his cave against the coming storm with an unflinching provision which has earned for him a most enviable reputation as a weather prophet.

Wild birds make still better objects of observation, because in the "large air" their actions are easily noted. Crows and swallows remain near home when a tempest is brewing; seagulls no longer venture out to sea, but hover over the fields or fly inland when wind and rain are near; swallows fly low and skim the water; and the robin broods melancholy in the bush, or seeks the shelter of a neighboring roof. These are only a few of the many creatures of the fields and the air which enable a man who has eyes to see to forecast the weather during the next few hours. The explanation of all this is to be found in the exceeding sensitiveness of most animals, especially those which are more or less wild, to atmospheric conditions. They are all constantly making forecasts after their own manner, and, as we have hinted, they are far more trustworthy than any devices of man toward this end.

Several ingenious attempts have recently been made to turn this unflinching instinct to some commercial use. A number of very unique living barometers have been put upon the market. The cheapest, and the one which will probably become the most popular, is the frog barometer. A small green frog is found in Germany, which always comes out of the water when cold or wet weather is approaching. These frogs are caught and kept in glass jars furnished with a tiny ladder and half filled with water. The frog weather prophet sits high and dry on the top of his ladder for several hours before a storm, and climbs down to the bottom when the weather is to be fair and clear. Other remarkable weather prophets are leeches, and we have heard of an old meteorologist who adjusted his barometer in such a way that the leeches would ring a little bell whenever a storm was approaching, and would remain silent when the weather was fair or setting fair. These creatures will also indicate the weather in the same way as the green frog referred to. If kept in a jar filled with water, they will climb up the sides when it is about to rain, and gather round the top.—London Standard.

#### BIVALVES AND TOOTH SHELLS.

The following are excerpts from a lecture delivered at the Academy of Natural Sciences, of Philadelphia, by Prof. Pilbry, of that institution.

Among the lamellibranchiata, the principal peculiarity is the gills, formed of two plates going down each side of the body. They may be known from all other mollusks by the bivalve shell in which they are closed. They have no eyes on the head and no tentacles. They lack the radula, or hard organ, for grinding the food; while all the other mollusks have this. Lacking this hard part for dividing the food, they live chiefly on infusoria, desmids and diatoms. The sole organ of protection for the bivalves is the shell, composed of two parts, usually fitting more or less exactly when closed. Some of the fishes have jaws strong enough to crush bivalves and swallow the whole animal and digest the contents. Some birds will carry them up into the air and let the shells drop and break, and then eat the contents.

Some mollusca are eaten by star fish; but the method by which the latter gets at them is not known. A number of bivalves are infested by a little crab called oyster crab. It lives in the mantle cavity of the bivalve and obtains its nutriment from the water which is brought in by the bivalve. It is not in any sense truly parasitic on the bivalve.

Aristotle first gave to the oyster crab its scientific name—*pinnotheres*, because found in the bivalve pinna, abounding in Greek waters.

Most oysters live partially or wholly buried in the mud, communicating with the surface by means of a very long siphon. The head end is always downward; so that they live really standing on the head. The body walls and the gills in the bivalve divide the body into two parts; First, the lower part, called the lower

branchial cavity, and the upper cavity above the gills. There is absolutely no connection between these two cavities of the bivalve, except through the gills and through the digestive tract, so that water will not freely pass from one to the other, but has to be filtered through the gills. The gills not only cause a current of water to flow all the time, but also aerate the blood. The same water supplies the food, so that in the bivalve there are always two totally distinct openings, although sometimes there is no organic dividing line between them, the division being made simply by proximity of the mantle at that place; through the lower the water is passing inward; through the upper, it is always passing outward.

The two valves of the bivalve are held together by a hinge along the upper margin, which is more or less of the consistence of cartilage in the fresh specimen, and which, being very elastic and contractile, tends always to keep the valves gaping open. This tendency to keep always open is counteracted by two strong muscles situated at the end of the body, and which, by their contraction, close the valves.

The nervous system of the bivalve is a very simple modification of that of all the other mollusca. There is a ring around the orifice, composed of several ganglia, of which the cerebral is the principal one. The siphons are formed in the simplest manner, by juxtaposition of the two mantles.

In some bivalves the siphon is extremely long, especially in a Pacific coast species—over a yard in length—and it takes the greater part of an afternoon to dig one out, though very edible when secured.

In the astragali the united mantle margins and the siphon have become calcified by the deposit of lime in their surface, and the result is a calcareous tube, having very little resemblance to an ordinary bivalve. At the foot end of the astragalus there are a great many perforations.

Another form in which the siphon is greatly developed is the tereid, or the ship worm. Some wood was submerged four years, and was nearly eaten out in that time.

The ship worm first enters by a minute hole, scarcely larger than a pin would make. The eggs, which float in the water, are caught and stuck against the pile, and the animal hatches in this minute hole, and thus perforates the wood, generally boring parallel to the grain, and avoiding running into one another's holes, and two holes seldom being found confluent. Their ravages are found sufficient to destroy most woodwork put into the water in temperate or tropical climates.

Mussels deeply buried practically never remove after once getting themselves into their holes.

The pholads bore into hard rock. The food of the pholads is tough and hard, and by rubbing against the stone and clay and sand, they gradually wear away a hole for themselves.

The pearl oyster has only one muscle. This arises by reason of the decrease of the interior muscle, which is nearest the mouth, and the consequent increase of the other muscle in order to fulfill the functions of both of them.

In the oyster there are a number of other conditions not found in ordinary bivalves. The two valves are rarely equal. This is the result of the fact that the oyster usually lies on one side or stands upright, and is attached by one valve to another oyster or rock or to branches of trees in the water.

Most people who eat oysters do not realize that the rather shapeless mass contains gills, muscles, nerves, digestive and reproductive organs—all the apparatus of a highly complicated living thing. Bivalves are such helpless things that we hardly ever give them credit for being alive, much less for having organs.

It may be interesting to see what the organization of an oyster is. On removing the top valve and the mantle, we find that they have two gills, lying on each side of the body, just within the muscle, and upon removing these, we find in the center the large adductor muscle and the labial palpi (comparatively very large in the oyster) and the digestive system, very much on the plan of the ordinary mussel. The dark portion is the liver. In all mollusca the liver is very highly developed. The mantle is free all the way round in the oyster, not united, and they are entirely without siphons, because the oysters, not boring at all, have no need of any siphons to convey the water to them. Oysters occur on nearly all coasts, and every part of the world has its own particular species.

The European oysters are much smaller than our Chesapeake Bay oysters. California oysters have a copper taste. In South Australia the oysters are as large as a dinner plate. On the coast of Japan I have seen oysters nearly two feet long. From the Loo Choo Islands I have had oysters sent me nine inches long and seven inches wide. One oyster would be enough for a small family.

The good parts of the oyster are largely due to the absence of the foot, which makes the clam so tough and hard; but the oyster, on account of all its life being attached, has the foot rudimentary. In fact, it is reduced to almost nothing, so that the greater part of the animal is simply the soft organs—the only hard organ being the adductor muscle. The foot is always most developed in the bivalves, which use it for digging—such as the razor shell and the river mussels; but in forms living all their lives attached, the foot is reduced to a mere rudiment.

The two parts of a bivalve are, of course, called the valves, being connected by a hinge above. In some forms the mechanism for opening these is an external hinge, as in the ordinary river mussels; but in others, as the beach clam, there is no external conventional hinge, the mechanism being an internal cushion or cartilage.

The accurate closing of the valves is insured by what are called teeth along the margin of the shell. These are interlocking processes which prevent side play and cause the valves, when closed, to close accurately one upon the other. The teeth of bivalves are of several kinds. The most primitive kind are a row of comb-like teeth along its great hinge line.

The interior of the shell also shows a good many characteristic marks. The mantle is the fleshy organ which lines the shell.

#### TOOTH SHELLS.

The scaphopod shell is simply a tooth, tapering to a

point at one end like the foot of a distinct head, and the whole with which knobbed at the blood lation to the gill. The heart pump are crowded in bivalves.

A scaphopod is a great creation of the stomach, and the sexes are individuals, in being unitary in water from greatest depth having deep (about tons as a length in sticking out the a scaphopod rake, by the end of the end and push the pegs would end of a way they for money, replaced the shell inches long. There are also a con-

principal gally taper other gent the middle end, taper is also a dentallium border.

When t and make sticks it by force traction of That is th lia. If on enlarges th inserted a end, so th soft parts two classe noon—the scaphopod shells—by valve shel there is a t

#### A NEW

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\* Spectra of a part of the Milky Way, under the College Obser

point at one end. The foot is a long organ, somewhat like the foot of bivalves, but very slender. They have a distinct head, in which the mouth is in the center of a row of little lobes or leaflets at the end of the head, and the whole surrounded by very numerous tentacles, with which it catches its prey. These tentacles are knobbed at the summit, but flexible. There is no gill, the blood being aerated simply by the water in its relation to the skin. The whole, general skin serves as a gill. There are no eyes; the ears are present, and the heart pumps arterial blood only. The head and feet are crowded close together; but this is also the case in bivalves.

A scaphopod always reminds me of a man who had a great tie around his body and was pulled by this great tie into a barrel, because of the very close relation of the head and feet. There is no very distinct stomach, and there is a very large and complex liver. The sexes are separate, that is, in two separate individuals, instead of (as in many bivalves) both sexes being united in one individual. The scaphopods live in water from one to two fathoms deep, down to the greatest depths which have been explored so far, some having been brought up from water 3,000 fathoms deep (about four miles). They live in muddy bottoms as a rule, immersed for nearly their whole length in the mud, only leaving the small end sticking upward; and in Oregon and in Washington the aborigines of that coast use the shells of scaphopods for money. The Indians make a sort of rake, by sticking pegs in a board and fastening that on the end of a long stick, and then go along in a canoe and push the stick down in the mud, and these small pegs would every once in awhile catch in the small end of a dentalium and bring them up; and in that way they would capture a large number and use them for money, before banks and the white man's currency replaced them.

The shells of the scaphopod range from two to three inches long to perhaps 1-16 inch for the smallest sort. There are only two principal genera of them, which is also a contrast to the other groups of mollusks. The principal genus is dentalium, in which the shell gradually tapers from a small end to a large end; and the other genus is casulus, in which the shell is swollen in the middle, and, while tapering most toward the upper end, tapers also toward the mouth end. In casulus there is also a modification of the foot; it is longer than in dentalium and ends with a disk with crenelated border.

When the animal is digging, it elongates this disk and makes it very much slenderer and more pointed and sticks it down into the mud; and then it inflates it by forcing water down through it, and, by the contraction of the foot, pulls the whole shell downward. That is the general mode of digging of all the dentalia. If one is put on the surface, it inserts the foot and enlarges the end and pulls on the muscle. The muscle is inserted at the foot and is fastened on at the smaller end, so that by its contraction the foot and all the soft parts are retracted into the shell, so that in the two classes of mollusks we have considered this afternoon—the lamellibranchiata, or bivalves, and the scaphopods—we can always distinguish them by the shells—by the fact that in the lamellibranchiata a two-valve shell is always present and in the scaphopods there is a two-valve shell open at both ends.

#### A NEW CLASSIFICATION OF STELLAR SPECTRA.\*

MANY of the recent advances in our knowledge of the constitution of the stars are traceable to Prof. Pickering's revival of Fraunhofer's mode of investigating stellar spectra. The endowment of this research by Mrs. Draper as a memorial to her husband, Dr. Henry Draper, has enabled Prof. Pickering to apply this method in two principal directions. First, a series of photographs was taken on a small scale to indicate the chief characteristics of the spectra of a very great number of stars; second, in the case of the brighter stars, another series was taken with greater dispersion with the view of facilitating an inquiry into the more minute features of each type of spectrum. The results of the first investigation are comprised in the well known "Draper Catalogue," giving particulars of the spectra of over 10,000 stars (Nature, vol. xiv, p. 427), and the research has now been advanced another stage by the publication of the results obtained along the second line of inquiry.

The new series of photographs has been taken with one to four objective prisms of 15° each in conjunction with the 11 inch Draper telescope of 153 inches focal length.

When four prisms were employed, the spectra were 8 centimeters long from H $\beta$  to H $\gamma$ , and with one prism 2 centimeters. Since only the brighter spectra could be photographed with the highest dispersion, some of the more typical of these were also photographed with one and two prisms in order to give a proper term of comparison with the spectra of the fainter stars. In all, 4,800 photographs of the spectra of 681 of the brighter stars north of declination -30° are included in the present discussion. By the use of plates stained with erythrosin the spectra of several stars have been photographed in the green and yellow.

As in all previous work involving considerable numbers of stellar spectra, it has been found that the spectra can be classified in large groups, between which there are intermediate varieties. "Large numbers of almost identical spectra are found, even when several hundred lines appear in each." The description of the spectra accordingly takes the form of an account of typical stars in the scheme of classification adopted, accompanied by tables of the lines which characterize the larger groups. No attempt has apparently been made to assign chemical origins to the various lines, so that the endeavor to arrive at a natural and satisfactory system of classification may be regarded as the most important part of the discussion.

The classification of stars has another object besides that of the mere grouping together of those which have similar spectra. It is generally believed that the various types of spectra represent different stages of

stellar evolution, but there are divergences of opinion as to the exact order in which the various types should follow each other. Dr. Vogel still holds, with some slight modifications, to the classification which he suggested in 1874, and believes that all the stars can be arranged along a descending line of temperature. Sir Norman Lockyer, who has adopted the same method of work as Prof. Pickering, and has also obtained large scale photographs of stellar spectra, finds evidence that there are some stars which are getting hotter, while others are becoming cooler, so that the two series of spectra can be recognized.

For the Draper Catalogue a somewhat arbitrary and provisional classification was adopted, but this has not been found sufficient to meet the requirements of the more detailed results which are now available.

Among the stars with line spectra, as previous researches have shown, there are a few sets of lines which occur with various relative intensities in different stars, each set in some degree varying bodily, and the new classification is based chiefly upon the distribution of these sets. As will appear later, the classification adopted by Miss Maury also takes account of the appearance as well as of the positions of spectral lines, and every care has been taken to eliminate instrumental sources of error.

Four distinct sets of lines are distinguished. The first includes the lines of hydrogen and calcium, and the remainder are thus described:

"Another class of lines frequently mentioned comprises those which are characteristic of the solar spectrum, excluding the lines of hydrogen and calcium. They are called 'solar' lines, except when referring to lines not contained in the solar spectrum, in which case they are called metallic lines.

"A third class of lines includes those known as 'Orion lines,' from the fact that they are conspicuous in the spectra of many stars belonging to the constellation Orion.

"Certain stars, such as a Cygni and  $\delta$  Canis Majoris, have spectra in which the majority of the lines, though probably identical in position with lines belonging to the solar spectrum, differ greatly in intensity, while others apparently are not represented in the solar spectrum. The characteristic lines of such stars should perhaps be regarded as forming a class distinct from those already described."

Bearing in mind these different classes of lines, the new system of classification can readily be understood. Excluding "composite" spectra and bright line stars, "the stars were arranged in an apparently progressive series, which in the present case was made to include twenty-two groups."

But it also appeared that a single series was inadequate to represent the peculiarities which presented themselves in certain cases, and that it would be more satisfactory to assume the existence of collateral series."

Three lines of progression are recognized in the earlier stages, and are called "divisions." Stars of division a are characterized by lines having the appearance with which we are familiar in the solar spectrum; that is, they are fine and sharp, if hydrogen and calcium be excluded. Those of division b are uniformly hazy as in  $\alpha$  Aquila, but otherwise present no notable differences in relative intensity from corresponding lines which are sharp in division a, so that "there appears to be no decided difference in the constitution of the stars belonging respectively to the two divisions." In division c the hydrogen lines are narrow and sharp and less intense than in the other divisions, while several lines, some of which do not correspond with solar lines, are of unusually great intensity; these are especially marked in  $\alpha$  Cygni.

Groups and divisions alike proceed by very gradual stages in some parts of the series, and it has frequently been found difficult to assign some of the stars their proper places.

In consequence of the adoption of the term "group," which has been in use for the last ten years in connection with Sir Norman Lockyer's classification, some confusion may possibly occur, as similarly numbered groups include different stars. To avoid ambiguity, it will therefore be necessary, in the case of the first seven groups at least, to specify the system of classification in question. In what follows, the Draper groups will be distinguished by the addition of the letter D to the number where necessary.

Of the twenty-two groups, the first five include stars in which the Orion lines are especially marked; the sixth contains stars intermediate between this type and the first type of Secchi, to which belong the stars in the seventh to the eleventh groups inclusive. The twelfth group is intermediate between Secchi's first and second types, and the stars included in groups thirteen to sixteen are of Secchi's second type. Groups seventeen to twenty inclusive correspond to Secchi's third type, and the groups twenty-one and twenty-two to the fourth and fifth types respectively. Besides these, two unnumbered groups are recognized, one containing composite spectra, apparently resolvable into two or more, and the other including stars of the Orion type which also show bright lines. Nebulae find no place among the numbered groups, but reference is made to a former paper (Ast. Nach., vol. 127, p. 1), in which it was suggested that the Wolf Rayet stars probably form a connecting link between the spectra of nebulae and those of the Orion type.

It is not possible within the limits of this notice to indicate the full details of the twenty-two groups with their subdivisions, but the general course of development which is suggested may be briefly stated.

In group I D, of which  $\epsilon$  Orionis is a type, the hydrogen lines are comparatively faint, while the Orion lines are strong, and "solar" lines are absent. Passing to Secchi's first type, through groups II D to V D, the Orion lines become fainter and less numerous until in the spectrum of Sirius (group VII D) all but two or three are wanting. Meanwhile solar lines have become numerous, and the hydrogen lines reach their maximum intensity. The transition to succeeding groups is very gradual, hydrogen lines thinning out and solar lines becoming stronger. Arriving at stars like Capella and the sun (group XIV D), the intensity of the hydrogen lines is little more than a tenth of that shown in Sirius, and they afterward continue to decrease, but less rapidly, down to the third type stars (groups XVII D to XX D), where they are inconspicuous. In the third type stars banded absorption appears,

and becomes more marked in each succeeding group, while the majority of the lines fade out in the later groups. An important feature of the series is the manifestation of extensive absorption in the later groups of second type stars and in those of the third type.

For the present, the series is regarded as ending with the spectra of the third type, stars following the twentieth group not being considered as having a place in the series exhibiting the gradual development of stellar spectra.

Spectra of division c are not found after the thirteenth group, and those of division b disappear still earlier, "so that the series tends to become more uniform as it progresses."

In connection with the new classification, it is remarked (p. 11) that "while it will be generally admitted that the series represents successive stages in stellar evolution, it may still be doubted whether the arrangement beginning with the Orion type, and here adopted, is in fact the natural order. It is strongly indicated, however, by the gradual falling off of the more refrangible rays in the successive groups, by the corresponding increase in the less refrangible rays, and by the occurrence of marked absorption at the close of the series. The comparative simplicity of the Orion spectra and the increasing complexity shown throughout the series lends additional weight to the argument. Finally, the prevalence of the Orion type in great nebulous regions, as in Orion and the Pleiades, indicates very emphatically that stars of this type are in an early stage of development."

It will be seen that the supposed evolutionary series has been arrived at without reference to temperature considerations. Nevertheless, a gradual reduction of temperature as the series progresses is suggested by the diminishing intensity of the more refrangible rays, so that, in the main series at least, the order is in all probability one of gradually reducing temperature.

As already remarked, the stars of Secchi's fourth type have been omitted from the supposed evolutionary series of spectra, for the reason that the few lines photographed "have not yet been identified with those of other classes of stars, owing to the total dissimilarity of the spectra." This dissimilarity is stated to extend to the yellow part of the spectrum, and is difficult to comprehend in the light of the more recent results obtained by Dr. McClean, who has shown that the spectrum of 132 Schj. contains many lines which are apparently identical with lines in the spectrum of  $\alpha$  Orionis (Monthly Notices, vol. lvii, p. 8). The existence of carbon absorption in the solar spectrum, however, is of itself, as Lockyer long ago insisted, a sufficient connecting link between stars resembling the sun and stars in which carbon absorption is predominant. A classification which excludes these stars from the evolutionary series cannot, therefore, be regarded as final.

It is perhaps unfortunate that the new classification was adopted prior to the discovery of terrestrial sources of helium. Many of the "Orion" lines are now known to be due to this gas, but not all of them, so that these lines may be subdivided into groups. In the preface to the volume Prof. Pickering remarks: "As the investigations were made several years ago, they could not take account of the recent discoveries respecting the spectrum of helium, which, if known at the time, might have had an important influence upon some of the conclusions. Such modifications could not now be introduced without practically rewriting the treatise, which is therefore published without change. A discussion of the relation of the spectra of stars of the Orion type to that of helium has, however, been made, and is contained in the supplementary notes."

The question of classification, however, is not the sole feature of interest possessed by the spectroscopic work at Harvard. Besides this, there are several tables which give the wave lengths of the lines depicted on the photographs, a general catalogue of the spectra, and copious remarks on the spectra of individual stars. In the case of the composite spectra it has been noted that in all but one,  $\alpha$  Andromeda, the spectrum of the earlier type was the fainter. The peculiarities of the spectrum of  $\gamma$  Cassiopeia, already recorded by Lockyer (Nature, vol. ii, p. 425), have been fully confirmed, and the additional fact observed that the entire region of the spectrum from  $\lambda$  4154.7 to 3927.1 appears brighter than the rest of the spectrum, although the brightening is not homogeneous. The possible importance of this feature is suggested by its occurrence also in stars of the first two groups of the new classification.

The complex phenomena in the variable spectrum of  $\beta$  Lyrae are fully detailed, and the composite character of the dark line spectrum detected at Kensington by Sir Norman Lockyer receives independent confirmation. It is concluded that "the bright bands accompany a spectrum approximately of group IV D (e. g.  $\gamma$  Orionis), which oscillates periodically over one of group VII D, division c" (e. g.  $\eta$  Leonis), a result which agrees very closely with Lockyer's conclusion that the two dark line stars were not very unlike  $\gamma$  Orionis and  $\beta$  Orionis. It is pointed out that the supposition of a system of three bodies explains most of the spectral phenomena of  $\beta$  Lyrae, but not all of them, and the rapid and complex transformations require to be continuously followed before a complete explanation can be given.

While fully aware of the difficulty attending the satisfactory reproduction of stellar spectra, we think the value of the volume would have been greatly increased by some attempt to give copies of photographs of as many as possible of the typical stars. Without such reproductions the classification can scarcely be adopted by others taking up the work unless photographs of all the typical stars are first obtained. In spite of this drawback, the volume is a magnificent contribution to celestial spectroscopy, and will be of the greatest value to those pursuing similar investigations. Prof. Pickering and his assistants are to be congratulated upon the excellence of this additional contribution to the Henry Draper Memorial.—A. Fowler, in Nature.

Paris' monumental Alexander III bridge to connect the esplanade of the Invalides with the Champs Elysees, is causing trouble. It was to be 180 ft. wide, but the engineers' estimates were so much below the actual cost that it will be only possible to build a bridge of half the width with much cheaper material for the money voted.

\* Spectra of bright stars, photographed with the 11 inch Draper telescope as a part of the Henry Draper Memorial, and discussed by Antonia C. Maury, under the direction of Edward C. Pickering. (Annals of Harvard College Observatory, vol. xxviii, part 1, 1897.)

## THE PIRATES OF MOROCCO.

NOT a single year passes that Morocco does not attract the attention of the civilized world in a disagreeable manner. The entire coast of Morocco is feared and avoided by ships of all nations, for piracy of the most unrestrained and boldest kind is always practiced there, one of the most dangerous points being Cape Tres Forcas, which extends far out into the sea. What difference does it make if Spain has garrisoned Melilla? Spanish power is effective only within gunshot. In the great bay that extends from here to Atalaya many sailing vessels have disappeared without leaving a trace. It is always the same story: a vessel coming from the West at night went too near the shore and was detained there by one of the frequent calms. In such a case only an opportune breeze could help it, unless a Spanish or English gunboat happened to pass that way. As soon as a helpless boat is discovered by the Riffians who are always on the lookout, smoke signals are lighted on the high points of the coast to call the bands together, and then the ship can only await an attack by the bold pirates armed to the teeth who row out to it in their boats.

The following incident shows that the robbers do not always have an easy time. In the latter part of the seventies the Marseilles brig Jeanette went to Senegal

Chambers's Journal. At Jena, in 1806, the Prussian loss was 21,000 out of a total of 105,000, and the French 19,000 out of a total of 90,000—that is to say, 40,000 casualties out of 195,000 engaged, or, roughly speaking, one in five. At Eylau, in 1807, the Russians lost 25,000 men out of 78,000; the French 30,000 out of 85,000—that is, for both sides, the appalling proportion of one in three! At Wagram, in 1809, the Austrian loss was 25,000 out of 100,000; the French 23,000 out of the same number. At Aspern, where Napoleon suffered his first defeat on May 21 and 22, 1809, the carnage was still greater, for the French lost 35,000 men out of 70,000—one-half their number—and the Austrians 20,000 out of 80,000. But even this awful butchery pales before that of Borodino in the Moscow campaign, for on that field the French left 50,000 dead and wounded out of 132,000 engaged, and the Russians 45,000 out of the same number—95,000 men slain or mutilated out of 264,000!

Now, the only battle in the latter half of the nineteenth century which can compare with Borodino in slaughter is that of Königgrätz, or Sadowa, in 1866, which ended the Austro-Prussian war. Out of 400,000 men engaged, 50,000 were killed or wounded—40,000 Austrians and 10,000 Prussians—one in eight only, as against one in three.

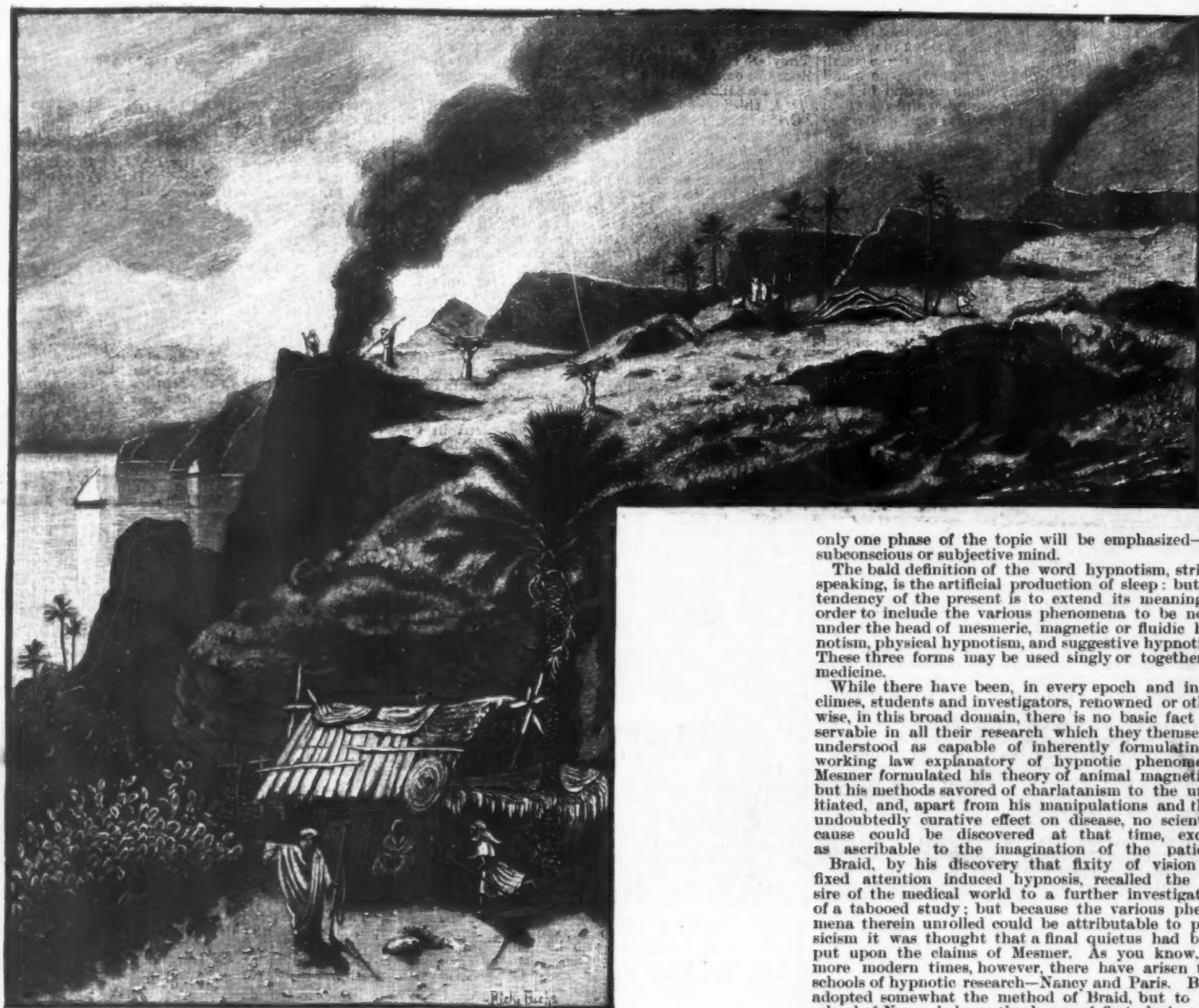
The most sanguinary battle in the American civil

clusively that war is no longer so murderous as it was. The alteration in tactics and in the formation of troops attacking has counteracted the superior precision and range of modern firearms. The shell, though its moral effect is greater, is not so destructive as the round shot, grape and canister of the old days playing upon troops advancing in line or column. The magazine rifle, incalculably superior in accuracy and penetrating power to the old Brown Bess, is not so deadly in its effect; for when it fails to kill outright, the wounds it inflicts with its tiny projectile are not nearly so ugly and crippling as those of the old spherical bullet, which smashed where the other glanced off.

## THE RELATION OF HYPNOTISM TO THE SUBCONSCIOUS MIND.\*

By GEORGE E. BILL, M.D., Harrisburg, Pa.

THE subject which it has been thought fit to discuss with the society at this time is one believed to be of very great import and latitude in the art and practice of medicine. So evident must this be to the thoughtful mind, that it would seem impossible, in the time allotted by the custom of the society, to more than enter the boundary of a field of inquiry the meaning and possibilities of which are so vast. Therefore,



SMOKE SIGNALS OF RIFFIANS ON THE COAST OF MOROCCO.

DRAWN BY RICHARD FUCHS.

with forty-two Italian workmen. They were weather-beaten fellows, mostly Calabrians, and each one was armed with a revolver and a knife and they carried their tools, which were flat axes with long handles. There was also a good little cannon on board. Adverse winds forced the captain out of his course, and one morning he found himself under the rocky coast south of Moedor. About ten o'clock the first pirate boats were close to his vessel. They were received by a hail of revolver balls and the cannon did good work. Two of the boats were sunken and the brown mob tried to get out of the dangerous neighborhood of the brig by swimming. The long handled axes proved very useful when an attempt was made to board the vessel. The whole battle did not last ten minutes, for the boats hurried away to land, followed by the shots of the victors, who were soon after helped away by a favorable northeast wind.—Illustrte Zeitung.

## MODERN LOSSES IN BATTLE.

COMPARE the slaughter in Napoleon's campaigns with the worst within living memory—with Gettysburg and Antietam, in the American civil war; with Königgrätz, in the Austro-Prussian war; with Sedan and Metz, in the Franco-German war, says a writer in

war was that of Antietam Creek, fought between McClellan and Lee on September 17, 1862, when, after repeated repulses, the Federals compelled the Confederates to retreat. Out of 100,000 men engaged, 26,469 were left on the field—the Federal loss being 12,469, and that of the Confederates 14,000; and that, remember, was before the era of breechloaders. At Gettysburg the combined losses were 43,000; but the number of men engaged was nearly double, and the proportion, therefore, was not quite so great as at Antietam.

Take, again, Leipzig and Waterloo, and contrast them with Sadowa and Sedan. At Leipzig the French lost 60,000 men out of 160,000, and the Allies 42,000 out of 288,000—102,000 out of a total of 348,000—more than double the ratio of Sadowa. Then at Waterloo the losses of the Allies amounted to 22,976 out of 83,000, and those of the French to upward of 30,000 out of 73,000—in other words, one man out of every three that fought that day was either killed or wounded. Now, at Sedan, under the awful crushing fire of the German guns, the French lost 30,000 out of 150,000 before they surrendered—a far smaller proportion than at Waterloo; while the Germans stated their losses at 3,022 killed and 5,909 wounded, out of the 250,000 brought into action.

These facts and figures seem to us to prove con-

only one phase of the topic will be emphasized—the subconscious or subjective mind.

The bald definition of the word hypnotism, strictly speaking, is the artificial production of sleep; but the tendency of the present is to extend its meaning, in order to include the various phenomena to be noted under the head of mesmerism, magnetic or fluidic hypnotism, physical hypnotism, and suggestive hypnotism. These three forms may be used singly or together in medicine.

While there have been, in every epoch and in all climes, students and investigators, renowned or otherwise, in this broad domain, there is no basic fact observable in all their research which they themselves understood as capable of inherently formulating a working law explanatory of hypnotic phenomena. Mesmer formulated his theory of animal magnetism, but his methods savored of charlatanism to the uninitiated, and, apart from his manipulations and their undoubtedly curative effect on disease, no scientific cause could be discovered at that time, except as ascribable to the imagination of the patient.

Braid, by his discovery that fixity of vision or fixed attention induced hypnosis, recalled the desire of the medical world to a further investigation of a tabooed study; but because the various phenomena therein unrolled could be attributable to physician it was thought that a final quietus had been put upon the claims of Mesmer. As you know, in more modern times, however, there have arisen two schools of hypnotic research—Nancy and Paris. Both adopted somewhat the method of Braid, but to the school of Nancy belongs the honor of first placing the study upon a proper basis in science, and of formulating a law. The school of Paris holds that the various phenomena of hypnotism pertain to neurosis, a conclusion obviously not always correct. Nancy, on the other hand, asserts that hypnotic phenomena pervade the most absolutely healthy organism. It is questionable if both together have not evolved laws of equal value out of the chaos obtaining in the times previous to their origin. Nancy has formulated the great law of suggestion, which underlies all actual scientific progress in the domain of hypnotism. On the other hand, the great name of Charcot and his gigantic labor have caused to be brought prominently before professional recognition and study that almost unknown realm, the subconscious mind. It is impossible to clearly perceive that the one is of value without the other—viz., the law of suggestion and the subconscious mind. Both are of profound and equal importance, neither can do without the other, and both work together in every hypnotic séance. Various are the means and methods employed to induce a condition of hypnosis. The loud command, the flashing mirror, the bright light, the forward or upward fixity of vision, the magnetic pass, the revolving chair, all have for their aim the subduing of the conscious objective mind, which cannot per se be hypnotically influenced. It is to this last fact that it is particularly desirable to call your attention, viz., that it is what Thomson Jay

\*Read before the Dauphin, Pa., County Medical Society, January 1, 1897.—From the New York Medical Journal.

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Hudson so aptly denominates as the subjective mind, existent in all sentient life, that is always influenced by the law of suggestion, either orally or mentally expressed, and not the objective mind, for the latter cannot be so influenced against its reason. This law of suggestion, so happily discovered, applicable alone to the subconscious mind, and a third fact in hypnotism, telepathy, to which your attention will again be called, explain as nothing else can the various phenomena of hypnotism. They are of fundamental value and pervade the whole question of hypnotism in medicine, and are of transcendent therapeutic import. As far back as the student can penetrate, a duality of mind has been recognized by the profoundest thinkers, and it would appear that modern research only emphasizes this ancient division as true.

The more commonly accepted division is known as the conscious and subconscious mind, but the most apt and most natural and distinctive phraseology, since it better accords with various symptomata of disease, would seem to be that of Hudson, who adopts as terms of distinction the words subjective and objective. He says, in effect, that the objective mind exercises its functions with its objective surroundings through the media of the special senses, and is that part of the mind necessarily connecting man in his entirety with physicism. By reason of its objective education it enables him to exist within his physical environment and its "highest function is that of reasoning."

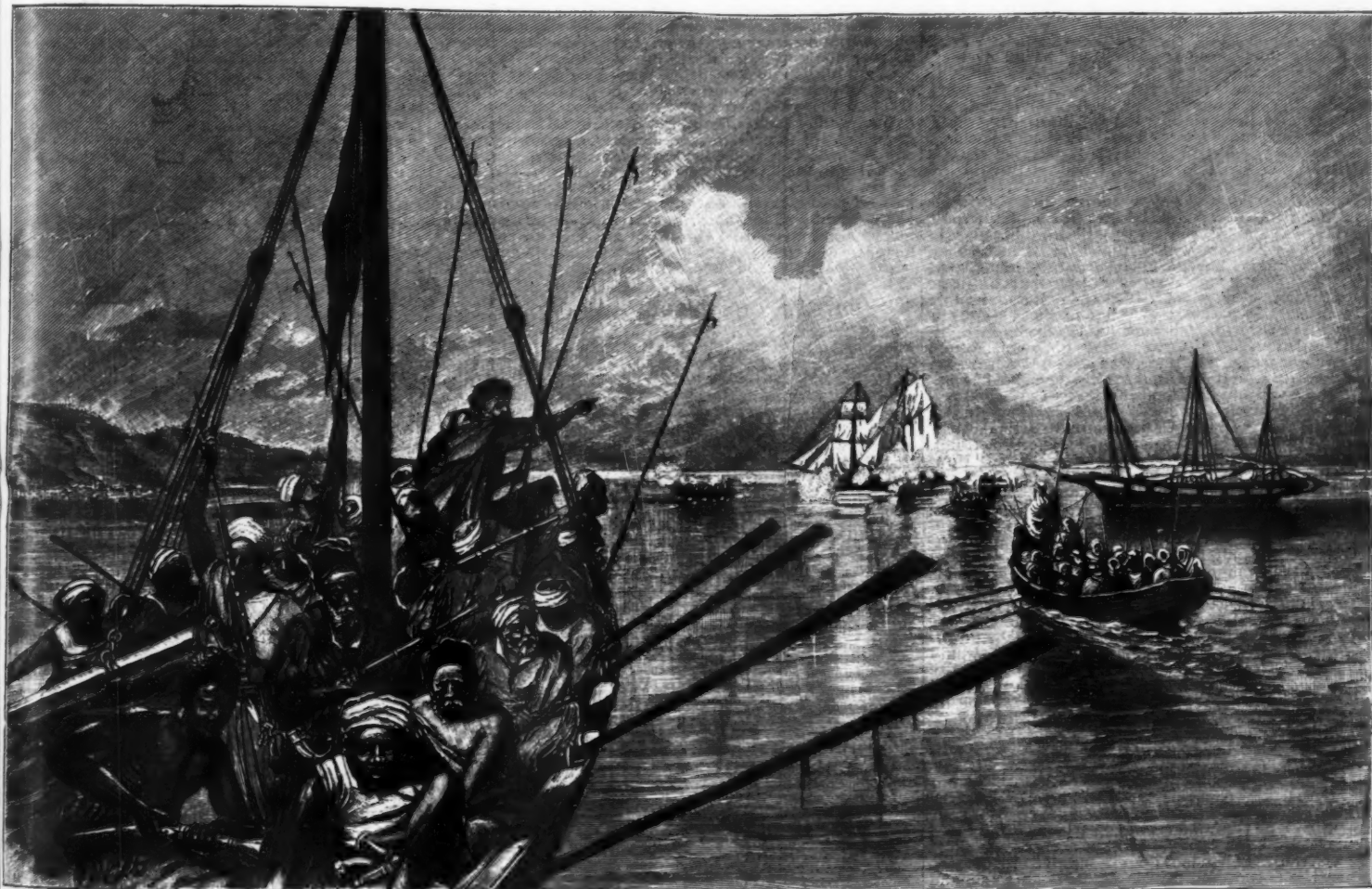
"The subjective mind takes cognizance of its environment by means independent of the physical senses. It perceives by intuition. It is the seat of the emotions and the storehouse of memory. It per-

ills, an attitude born of fear, which is an inductive hypnotic element of itself, a condition of entreaty that he be better, of hope that he be aided, of faith that he be cured. This obvious and suggestive fact in the above status being of such pregnant importance, how can we not observe then in this very condition of society a therapeutic buckler capable of fending the arrows of disease, functional or organic? Why, then, should the physician shoot the envenomed shaft of ridicule against so potent a shield from disease as hypnosis? If hypnotism has been synonymous with quackery, it should be no longer so regarded by the medical profession.

It has been found that there are in the main two general divisions of hypnotic effort. One makes use of the means above noted for its induction, and always presupposes a concentration on the part of the subject and operator, and demands the entire recognition of the operator by the patient and oblivion to all other externals, and is the form of hypnosis in most general use. This form demands also the conscious surrender of the subject to the objective will of the operator, and is objectionable therapeutically, because its practice leads to vacillating volition, except in selected cases, embraced under sexual perversion, alcoholism, morphinism, and criminal impulse.

There is another form, however, which can be more widely employed with benefit to the majority of patients with no harmful results to their objective will power, and with increasing aid to the physician in controlling the symptomata of disease and emasculating the subjective mind of the patient from its bodily environment of suffering. This form of hypnosis de-

ness or the imagination of the patient, and too often, therefore, disbelieved by the practitioner. Means adopted for the dissipation of the objective symptoms very often efface the majority of the subjective, but not invariably. If disease symptoms, subjective or objective, are dependent, as it would seem, on disturbances in the equilibrium of nerve action between the cerebrospinal and sympathetic systems, then these oscillations in nervous energy would account for very many of the subjective symptomata complained of. It is at this point that the aid of the nervous force of the operator, through emphatic and confident oral or mental suggestion, can influence and direct the perverted nervous force of the sufferer and lead it back to the wonted channel of health by commanding the subjective mind to resume its proper control of body function. If the telepathic ability of the operator is complete through training, the vast majority of the subjective symptomata of the patient are easily enunciated by him to the patient, the expectant attention of the latter is closely held, his astonishment, delight, and sometimes fear are aroused, and the confidence of both subject and operator is gained. The amount of information culled by this method is often surprising, as to the etiology of the patient's condition of ill health, its amount, and the tendency therein toward recovery or death. Of course, the various aids of an objective training are to be employed, such as physiognomical indications, vocal tones, ocular expressions, and an objective examination of the patient is to be always insisted upon, in order to objectively verify the clues obtained in a subjective diagnostic or prognostic reading. Very often the disappearance of this or that



A MERCHANT VESSEL ATTACKED BY RIFFIANS OFF THE COAST OF MOROCCO.—DRAWN BY RICHARD FUCHS.

forms its highest functions when the objective senses are in abeyance. In a word, it is that intelligence which makes itself manifest in a hypnotic subject when he is in a state of somnambulism."

The distinction herein expressed offers to your reader the best explanation, in its applicability, of the universal value of the law of suggestion, in the various phenomena of disease. It would seem on profound thought that the subjective mind does, as Hudson asserts, "preside over the emotions and functions of the body," and as a corollary it may be added that it also controls the action of the sympathetic, if measurably so in the male, still more so in the female, by reason of her greater richness of sympathetic endowment; for in the deepest hypnotic stages the female observes through the solar plexus, the male through the pineal gland and medulla oblongata.

Now, it is most instructive and most curious to observe that no physician and no patient are thrown into each other's contact in any walk of life, lay or medical, without these bases of hypnotism unconsciously becoming apparent, and it is this fact, of such wide significance, of such universal bearing, from the beginning of medical times until now, that the medical profession as a whole has either ignored, has been unconscious of, or has even unconsciously used in therapeutics. It is even illustrated in the placebo. That this is eminently true springs from the fact that the physician's attitude, his entire status, public or private, is one of command, of direction, of leadership, while that of the patient is one of submission to an

mands complete relaxation on the part of the operator as well as the subject, and by reason of the universal status of the patient and physician, above noted, can be the more generally used and with more far-reaching results. In it there is no subtending of the will, no exhaustion on the part of the patient or operator. It is that form of hypnotic effort demanding no fixity or tension of will power, and depends only upon constant iteration and reiteration of suggestions, oral or mental, of the directing mind of the operator upon the subject. It yields most brilliant and oftentimes most astonishing results, and depends upon a fact in psychism denominated as telepathy. Telepathy\* is defined as "the power of one mind to communicate intelligence to another otherwise than through the recognized channels of the senses." That this faculty is inherent in man is no longer a matter of supposition, for it is universally prevalent, and is of as much value in hypnotism as the law of suggestion and the subjective mind. It is through the medium of telepathy that the subjective mind and the subjective symptomata of the patient are recognized. Now, it is to be observed that symptomata of suffering on the part of every patient are known as subjective and objective. Ordinarily objective symptomata are easily noticed as disturbances in bodily pulse, temperature, coloring, secretæ, excreta, growth or shrinkage, and means are adopted for their amelioration or effacement. But the subjective symptomata are but little commented upon, and while they may claim the paramount attention of the patient in the gamut of suffering, their verbal or oral announcement is too often ascribed to the nervous-

symptom can be predicted even to its exact time. This prediction involves, of course, oral or mental suggestions, and at times no one is more astonished at the outcome than the operator himself. It is not always necessary to be within vocal or visual distance of the subject to successfully launch a therapeutic suggestion, nor is it requisite to know or to have met the subject even. Personally, this observation has been proved in actual practice, a remarkable example of which will be presented. To summarize, it may be said that hypnosis takes cognizance of—

- (a) The law of suggestion.
- (b) The existence of a subjective and an objective mind.
- (c) The fact of telepathy—all of which factors are universal; and last, though possibly not least, of—
- (d) A medium of communication.

What the latter is, what it consists of, has not yet nor will it be distinctly formulated until the laws of dynamics have been irrefutably settled and agreed upon; but the suggestion is offered that this medium of communication may be something analogous to, if it is not, interplanetary ether. If, as is supposed, that interplanetary ether offers the only reasonable medium for the transmission and transference of light, heat, electricity, or magnetism, from their primary sources in physicism, perhaps it may, indeed, be the manner and way and medium of the transference, broadly speaking, of psychism from point to point or along any distance of greater or lesser extent; for it would seem that this interplanetary ether pervades all things and entities and forces in this universe.

It is customary to adduce a series of cases in actual practice illustrative of the topic discussed. It is ex-

\*T. J. Hudson. The Law of Psychic Phenomena.

†Id. opus, page 29.

\*Thomson Jay Hudson. A Scientific Demonstration of a Future Life.

treribly odious to your reader, by reason of the personality involved in a subject of this nature, to follow the usual custom, since a proper personal modesty shrinks from such an exposure; but, while there is nothing in therapeutic results in the main extremely novel to one who habitually and scientifically studies the phenomena of psychism, yet it may be wise to cite one case in point, since it illustrates so remarkably the power of telepathic suggestion on the subjective mind of the mother of one of our local physicians who was ill unto death, and whose condition of illness, by reason of her age and disease, precluded all hope of recovery by ordinary therapeutic means. This case, indeed, bears corroboration in every essential detail, and through professional desire of my confrère is allowed to be discussed. At the outset it must be said that conversational personalities must be indulged in for purposes of illustration.

On a Thursday evening last summer, about 6:45 o'clock, my colleague called and announced that his mother was dying of gangrene of the right foot. Two weeks previously he had told me that there had developed in the joint of the large toe of her right foot an abscess resulting from a shoe pressure on a bunion, and had sought advice therefor, and also said that she had suffered some years from diabetes mellitus. Here was a case presenting grave constitutional and local lesions. He stated that the local lesion had involved all of the toes, which had turned black and had withered, and that there was a most offensive, tough, and deep slough of the upper portion of the foot, extending to the ankle; that there was an intermittent pulse, atheromatous arterial condition, stupor, anorexia, nausea, no thirst, and a constant desire to die. Her age precluded an operation, as she was of too low a vitality to override such a procedure. "Could I go with him to see her on Saturday?" "Yes; but of what avail, since you think that death is imminent?" "I don't know, but I want you to see her at all events." "Does she suffer any pain?" "No; that is just the trouble. She betrays no reaction, and, being so, I consider the case hopeless." "If we could bring on a reaction of her nervous system," I tentatively suggested, "and arouse her with pain, without additional shock, perhaps something could be done." "That is just the point, but I do not see how you can do it." This last remark of his gave me a clew to follow in hypnotism. "Where does your mother live? How far from here, and in what direction?" He pointed out the direction and told me sixteen miles, and her place of residence. "Are you willing that I try hypnotism on your mother, for I have an idea that it may do her some good?" "Yes; but you will have to wait until we go Saturday, won't you?" "No; there is one way we may reach the patient." "What is that?" "Telepathy," I answered. Thereat he laughed outright. This nettled me. "Fix your mind on your mother. Get her image mentally impressed as you last saw her this afternoon, and I will not only describe her appearance, face, and position in bed, but the room, and its location and surroundings." He laughingly did so, saying he was ready. In all, save one particular, the patient and locale were correctly described. This assured me that the way was open for success. "Now, give me your hand. To get here to my office you travel in such a circuit and such a direction. It will only be necessary for me to retrace your steps to get there in mind." "Now, what time is it?" "Quarter past seven."

At once, with all the power I could summon, and retracing in my mind the path he had taken to come to my office from his mother, I launched upon the subjective mind of the patient the suggestion that she should at once suffer pain and continual pain in the right foot, and that her bodily functions should be restored. We took the time, and agreed that we would question the patient's husband as to the probability of pain occurring near 7:15 o'clock Thursday evening, and whether she suffered more pain from that time up to Saturday on our arrival than she had previously exhibited. The doctor left skeptical, but I persisted in saying that I believed the experiment would be a success and that we would find that she would complain continually, while awake, of the pain. On our arrival the father told us she was worse. "Has she suffered much pain?" "Oh, yes." "When did the pain come on?" "Somewhere between seven and eight o'clock Thursday evening, but nearer seven than eight." Getting bandages and material ready, the father, the doctor, and myself entered the room, and with no special care and unnoticed by the patient. She lay in a stupor on her left side, her back toward us. The father stood at the foot of the bed, the doctor next at the side, and I near the head. I asked the two gentlemen to join hands, and the father to extend his right hand over his wife's foot. "Now, when I am ready, please notice what you both feel and observe the patient." I mentally, emphatically and confidently, commanded the patient to suffer pain, and that her subjective mind should resume control of her functions, that she should get well, and commanded aloud, "Now suffer pain, pain, reaction." The father felt a shock, the doctor nothing, the mother at once turned on her back with the cry, which I can never forget, dramatic in its intensity, "Oh, what are you doing that you make me suffer so much pain? I can't stand it! I want to die!" Her foot and limb twitched spasmodically with the agony she was suffering. "What have you to say now, doctor, to this form of hypnotism and its effect?" "I don't know, it is beyond my understanding." The father wonderingly exclaimed, "It is mighty strange. It is wonderful." So far I was satisfied, but when I saw the foot unbanded and recognized the gravity of the case, my objective training through my objective mind said: "No, she cannot recover." My subjective mind said: "You must gather courage and not yield to the autosuggestion of your objective mind, or she will die." While the foot was dressed I stood at the foot of the bed and mentally and orally commanded that the foot should freely discharge pus until we returned on Monday. As we were returning home the doctor asked: "Well, what do you think? Is she going to get well?" "My objective training and experience reply No, but if we find on Monday that the foot discharges pus I shall have more hope. My subjective mind assures me, however, that she will get well, against all reason." On Monday the father said: "The foot has discharged more pus between Saturday and to-day than during the previous

two weeks, but she won't take my medicine. She says it is a sin to keep her alive when she wants to die and get rid of so much pain."

The difficulty in treating this case hypnotically lay in the fact that the patient, through her own autosuggestion that she would die, strongly militated the suggestive command of the consultant that she must get well whether she wished it or not, and was an autosuggestion that had to be continually fought by your reader throughout the entire conduct of the case. Her mind was affected through the double lesion and the toxæmia, and she has no recollection of the events and symptoms that marked her illness. For several long weeks thrice weekly visits were made, when gradual hypnotic control was gained over the patient, and the continual, emphatic, and confident suggestions were made that she should recover, and enjoy the rest of her life in comfort. I am assured by her son that she has greatly changed in appearance, that she enjoys life, and that the sugar has markedly lessened. The contour of the foot is restored, with the exception of the loss of all the toes except the big one.

This case illustrates the possibilities of hypnotism, wherein one had not the normal waking intelligence of the subject on which to more easily hypnotically operate, and no objective mind to help the operator; but it shows, indeed, the paramount importance of the subjective mind in hypnotic effort, evidences the existence of telepathy, and indicates, through the path originally taken to launch the initial suggestion, that there must be a physical medium of communication between mind and mind apart from the media of the special senses; for your reader had never seen the patient, the village, nor the road to the room in which she lay ill unto death.

It must be emphatically stated that the reader does not believe in marvels or modern supernaturalism, but on the contrary does assert that there is always a cause for a therapeutic result, and that there are laws established on a scientific basis capable not only of explaining therapeutic results in hypnotism, but also that there are facts which should establish medical hypnosis on such natural, physical, and mental grounds as to forever debar all ridicule, surmising, or odium from a field of medical research which promises such rich results in the future to therapeutics.

The complex man, being composed of mind and matter, cannot be successfully treated either by drugs alone or suggestion alone; but in this age of sordid materialism there are entirely too great claims made for physicism to the exclusion of psychism, which dominates, it must be concluded, the former.

#### SMITH'S IMPROVED METHOD OF GRAFTING.

THIS method of grafting is recommended for fruit or other trees, in the orchard and garden, and especially

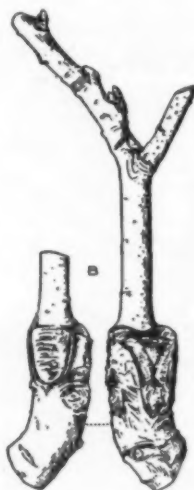


FIG. 1.—An Old and Defective Method of Rind Grafting.

in exposed situations. The scion has a threefold grip of the stock or branch it is placed upon, and this is covered during the first year by the union. The method has been tested in Shropshire and neighboring counties, from my instructions, and has proved a success during the last three years, a vigorous growth having always followed. It can be employed upon stocks varying in size from half an inch to an inch and a half

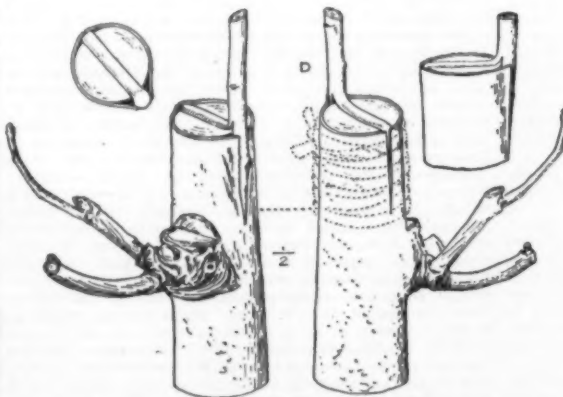


FIG. 2.—Large Branches—Grafted According to the Method Recommended, Showing the Graft in Position before it is Covered with Wax.

in diameter, and scions may be made from wood one or two years old in the case of fruit trees.

Fig. 1 represents an old mode of rind grafting, the defects of which can be seen at the place of union. Figs. 2 and 3 illustrate the preparation of stock and scion for the method that I advocate—in the one case upon a small stock and in the other upon a larger one. In Fig. 4 the graft is shown when completed and waxed.

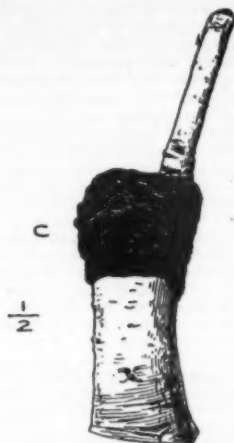


FIG. 4.—A Completed Graft—New Style.

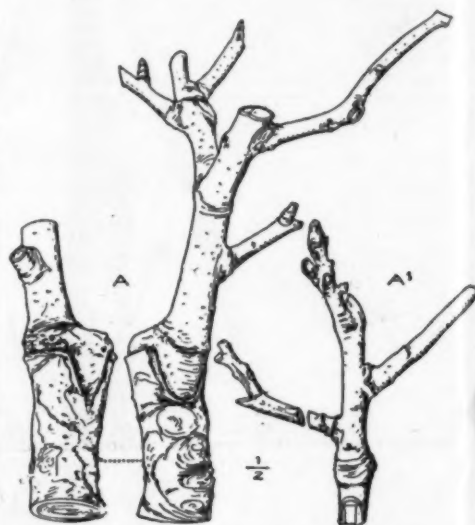


FIG. 5.—Method of Grafting Recommended—Showing the Graft after the First Year's Growth.

and in Fig. 5 is illustrated the effect of one year's growth after the grafting has been done. It will be seen to offer more than ordinary resistance against the wind.—Robert Smith, Horticultural Instructor, Shropshire County Council, in the Gardeners' Chronicle.

#### THE SIGNIFICANCE OF HOLES IN ARCHEOLOGY.\*

EVEN now, at the close of this nineteenth century, people, and those not by any means the most ignorant, continue to hoard lucky money—that is, coins in which a hole has been bored by unknown hands. To find or to receive such a coin means good luck far beyond its intrinsic value, for the luck is not so much in the money as in the hole. In this article I propose to show that this present day harmless, but apparently unmeaning, superstition has its root in necromancy or ancestor worship, and can be traced back in various forms, but always in connection with "medicine"—that is, witch-

\* Condensed from an interesting article by Mr. A. W. Buckland, F.A.S., in the Antiquary.

† Throughout this article the term "medicine" is used in the Shamanistic sense, being equivalent to witchcraft, as employed in healing ceremonies by "witch doctors."

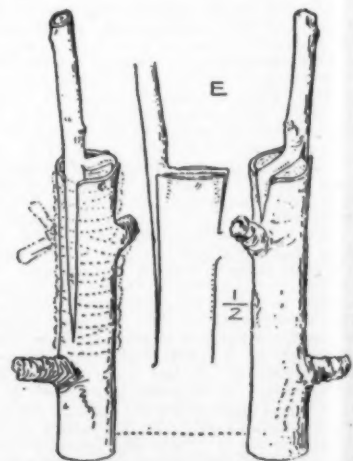


FIG. 3.—Small Branches Grafted, and Ready for Waxing.

craft—lithic t... an ana... as luck... very h... with n... are use... the nigh... sitting... from an... in Note... charm... Stone t... over hy... of Duci... in 188... teeth f... were p... This m... and sim... peasant... kept in... behind... stable d... The lat... of Eng... stones... tied to... stones u... of the N... of Scotl... beads f... cure of... stones u... flat obl... notched... uly use... and two... byres us... craft. I... also to... as a cha... to show... sidered... averting... traced to... The R... Cherokee... shamans... benefit o... enemies... of death... beads an... fingers a... success... formula... client, th... thumb o... the victi... upon the... makes a... it the fa... with a s... also asso... ing a pr... takes pla... head, or... medicina... drops a r... up the ro... ate the... the Nava... an impo... quiose w... and blue... tal dipp... month, a... head and... afterwar... points, a... whole, an... face, it li... the magi... part in v... ving to t... as we kn... other ai... propertie... prior to... blessed b... benefit o... and silve... while ear... for weak... Curious... tributed... Mr. Bou... "The M... nian Rep... says that... ual decad... venated... projectin... pal, on t... stone of... purpose... and Acon... or not su... to the me... ing Rock... which the... procession... the face c... ent date... which wa... The St... British... cent peri... the shipb... no means... Vol. I, p... See "Sa... Moon-y... pp... The bes... ger upon wh... stroked by... "Breece and... of Days," p...

craft—to the very earliest ages, probably even to prehistoric times. In various parts of Great Britain we find an analogue of lucky money in great stones known as lucky stones, mare stones, or hag stones, which are very highly valued. Most of these are small pebbles, with natural holes, indentations, or cups in them; they are used for driving away hags or witches, especially the nightmare, which is supposed to be caused by a witch sitting upon the stomach of the sufferer. An abstract from an old book of Queen Elizabeth's time is given in Notes and Queries,\* containing "a fonde foolishhe" charm for driving away the nightmare. "Take a Flynt Stone that hath a hole of hys owne kinde and hang it over hym." Three of these were exhibited by the Earl of Ducie at a meeting of the Anthropological Institute in 1887, one being remarkable from having two human teeth fixed in the natural hole of the stone. The teeth were probably used to increase the luck of the stone. This mare stone had been in one house seventy years; and similar stones seem to be in common use among the peasants and fisher folk of the North of Scotland, being kept in the bed to warn off nightmare, hung in byres behind cows to insure safety in calving, or hung on stable doors to prevent horses from being hag ridden. The latter use is, I believe, still common in many parts of England, for I have frequently seen in Wiltshire stones, and sometimes a piece of cork with a hole in it, tied to the keys of the stable. Several of these holed stones used as amulets are described in the catalogue of the National Museum of the Society of Antiquaries of Scotland. Among these amulets we find four amber beads formerly used in Argyllshire as charms for the cure of blindness, and four spindle whorls called adder stones used as charms against diseases of cattle; also a flat oblong stone less than a quarter of an inch thick notched at the edges and pierced with two holes, formerly used as a charm for the cure of diseases in Islay, and two perforated pieces of sandstone found in cowbys used as a protection for the cattle against witchcraft. In the foreign portion of the same collection is also to be seen a vertebra of a gazelle used in Palestine as a charm against evil spirits. I cite these instances to show that both natural and artificial holes were considered of the same value for the cure of disease and averting witchcraft, and that the same idea may be traced to Palestine.

The Red Indian medicine men, especially among the Cherokees, use beads to symbolize persons, and their shamans take beads and with them work spells for the benefit of their employer, and for the destruction of his enemies. Red is the lucky color and black the emblem of death. By some extraordinary manipulation these beads are made to move up and down the outstretched fingers of the shaman, and by their movements the success or failure of the spell is foretold. A certain formula or prayer is used to invoke success upon the client, the red bead being held between the finger and thumb of the right hand, while a black bead typifying the victim is held in the left. Curses are called down upon the latter, and then the shaman, stooping down, makes a hole in the ground with his finger, "drops into it the fatal black bead, and buries it out of sight with a stamp of the foot." Purification by water is also associated with this ceremony, the shaman addressing a prayer to the stream near which the incantation takes place, while the client pours the water over his head, or dips in the stream seven times. In gathering medicinal plants, also, the Cherokee medicine man drops a red or white bead into the hole made in pulling up the root, in order, Mr. Mooney thinks, to compensate the earth for the plant torn from her bosom. In the Navajo myth of the creation of the sun, beads play an important part. Two women, known as the Turquoise woman and the White Shell woman, take white and blue beads, draw a circle round them with a crystal dipped in corn pollen, mark them with eyes and mouth, and produce a slight light from the white shell bead and a greater light from the turquoise. These are afterward multiplied by twelve at each of the cardinal points, and with a crystal a circle is drawn round the whole, and the crystal being held over the turquoise face, it lights up and becomes the sun. Here we get the magic circle which always plays such an important part in witchcraft, a survival of which seems still to cling to that symbolic circle, the wedding ring, which, as we know, is used to cure a sty on the eyelid and other ailments, and to promote dreams.† Curative properties are not confined to the wedding ring, for, prior to the Reformation, cramp rings were solemnly blessed by kings of England, and distributed for the benefit of those afflicted with cramp or rheumatism; and silver rings are still worn for the same purpose, while earrings are commonly supposed to be a specific for weak eyes.

Curious instances of the healing properties still attributed to sacred stones in America are given by Mr. Bourke in his very interesting article, entitled "The Medicine Men of the Apache" in the Smithsonian Report of the Bureau of Ethnology (1888). He says that medicine men seem to be subject "to a gradual decadence of their abilities, which can only be rejuvenated by rubbing the back against a sacred stone projecting from the ground in the country of the Walapai, on the Atlantic and Pacific railroad." Another stone of the same kind was formerly used for the same purpose by the medicine men of the Pueblos of Laguna and Acoma, and he adds, "I am unable to say whether or not such recuperative properties were ever ascribed to the medicine stone at the Sioux agency near Standing Rock, South Dak., or to the great stone around which the medicine men of Tusayan marched in solemn procession in their snake dance; but I can say that in the face of the latter, each time that I saw it (at different dates between 1874 and 1881) there was a niche which was filled with votive offerings."

The St. Louis Age of Steel says: "The growth of the British mercantile marine, notwithstanding some recent periods of depression and the general revival of the shipbuilding industries in other countries, has by no means reached the decadence some suppose. In less

than a decade the tables show an increase of 3,200,000 tons. A large percentage of this gain is due to the building of large steamships. In speaking of this matter a British contemporary says: 'We have 8,375 steamers of 9,900,000 tons. In fact, in ten years we have added over 9,500,000 tons of steamers, even after all allowance is made for sales, wrecks and waste generally, while the sailing tonnage is actually less than it was ten years ago by 462,000 tons. Antecedent to 1892 the average for some years was nearer 500,000 tons, although, in 1887, a minimum was reached with an addition of 46,690 tons.' That the shipbuilding industry will eventually be more evenly distributed among various nations is a foregone conclusion, and in this inevitable result Great Britain must be the greatest loser from competition."

#### GLACIERS.

Constructive Work of Glaciers: its Peculiarities—Moraines, Lateral, Medial, Ground and Terminal; Drumlins—Erratics and Perched Blocks. Constructions by the Combined Work of Ice and Water—Kames and Eskers—Overwash and Glacial Sand Plains.

THE following are excerpts from a lecture at Wagner Institute, Philadelphia, by Prof. W. B. Scott, of Princeton University.

Glaciers are found in Greenland, Alaska, the Antarctic Continent and elsewhere. A glacier does not move like a mass of ice, by sliding. Gravity is the moving force in both cases; but the ice of a glacier flows—it acts like a plastic body.

The different classifications of glaciers are based on size. We have, in the first place, the Alpine glaciers, because of their typical development in the Alps. They may be compared with small rivers and streams that occupy valleys at first carved out by water, and later occupied by these great streams of ice.

Among the Alps of southeastern Alaska the convergence of a number of streams has produced a glacier covering over 15 square miles of country. The movement of this great glacier is exceedingly sluggish, and in certain parts of it, it does not move at all; there you find it covered many feet deep with soil and rocks; and on parts of it is growing a luxuriant vegetation. It seems impossible to imagine this flora—you can't exactly call them forests, because they are trees and bushes, ferns and May apples, with laurels—growing most luxuriantly with a thousand feet of ice beneath them.

Then we have the great ice sheets comparable to seas of ice. As examples, we have the Greenland glaciers—the great ice cap, which covers thousands of square miles. The whole country from the coast mountains inward is covered a depth of several thousand feet with ice which is gradually flowing outward—eastward and westward to the Atlantic and Baffin's Bay. From this great inland sheet descend glaciers of the Alpine type, which fill the valleys, many of them coming down to the water; many of them ending a mile or so inland.

It is always easy to identify the work of a glacier. The same ice mass will be destructive in one place and reconstructive in another. It is a question of rapidity of flow; so we distinguish in the glacier the central zone and the peripheral zone. The central is where depth and rapidity of flow are at maximum; consequently, no material accumulation is possible at the center. Fifty feet a day is a tremendous movement for a glacier. This comparatively rapid flow carries away all the loose material, sweeping the rocks bare. As the glacier sweeps away this material, a great many stones of all sizes become frozen in the bottom and are dragged and pushed along. The rock bottom is scored; each stone, like a great chisel, cuts and grooves, and the parallel lines are kept perfectly true as long as the stones keep their relative positions.

Then again the glacier makes a curious kind of rock effect, "ruche moutons," looking like a flock of sheep lying down. There is one steep side and one gentle side; and you always know that the movement of ice is in this direction—that the gentle side is upstream and the steep side is downstream; because, while you find this side polished by the sand and clay which has been pushed over it by the moving ice, this downstream side, never having been subjected to pressure, may still retain its primeval roughness. Besides the scoring and polishing of the rocks produced by the glacier, it markedly changes the shape of the valleys; an Alpine or valley glacier always changes the character of the valley in which it occurs, such valleys originating through the action of water. The typical form of a stream valley is a V shape, much narrower at the bottom than at the top. The ice filling the valley commences to tear out the sides, and instead of having a V shape, you will get a U shape with a flat bottom. When the glacier has retreated, the valley has a peculiar shape water never gives.

Then a true fjord is unmistakable evidence of glacial action. A fjord is a valley of terrestrial origin which the sea has invaded; and the picturesque beauty of the coasts of Norway, over which travelers are wild, is due to this fact. You have these extraordinarily precipitous-sided rock valleys into which the sea penetrates for many miles, and each one of these fjords is a valley first cut out by water; secondly, modeled by the moving ice into the peculiar glacial forms; and thirdly, submerged so that the sea has come over it. Some of these fjords have two or three thousand feet of water in them. Here, evidently, the fjord has been greatly deepened by the great glaciers which at one time flowed out through them.

The rocks are not solid sheets of material, they are broken up by innumerable joints into blocks; and so, wherever glacial ice would find a block, it would shove it along; and these separate blocks would be worked out one after another and the valley shaped and modeled in this peculiar fashion.

Dealing with the constructive work of glaciers, the North American continent, down to the latitude of 40°, is modified in its topography by the great sheets of ice. In the far north, where the glaciers accumulated and were thickest and swiftest, we have the central zone, with hardly any soil left, as in much of northern Canada, where there is nothing scarcely but naked rock; but from southern Canada to latitude 40° we have a million square miles of country covered to an enormous depth with drift, which is the generic

and general term for the material deposited by the great ice sheets; because these were not single valley glaciers, but sheets comparable to those of Greenland and the Antarctic. This drift is of many kinds. The drift's relation to the ice that brought it, whether carried on top of the glacier, in the middle, or shoved along underneath—all these determine the characteristic topographical features which the drift assumes.

So we have the glacial moraines. The scientific study of glaciers began in French Switzerland; and so, just as nearly all our terms regarding volcanoes, so most of our terms regarding glaciers are French. Moraine means the line of rubbish the glacier carries. We have in a valley glacier numbers of moraines—among them, lateral moraines, carried along the side. These are rock masses tumbled down upon the glacier from the cliffs; and if there are no overhanging cliffs—as in Greenland—then you will get no lateral moraine; because there the cliffs are buried out of sight in the enormously thick field of ice. It looks very strange when you first go to Switzerland to see a stream of ice a mile wide, with a great regular line of stones—from a thousand tons down to grains of sand—piled up in long lines in the middle of the glacier, half a mile out from the sides; until you find that the immense moraine is produced by two branch glaciers.

The material underneath the glacier (as long as the glacier moves with some speed) is pushed with it; but when thinned down by melting and you get out into the peripheral zone (with weight and speed reduced) all this stuff is left behind and the glacier rides on over it. This is the ground moraine.

The lower end of a glacier—whether a valley glacier or a great ice sheet—is determined by the point where melting and flow just balance; consequently, when the ice reaches this point, down goes everything that the ice has been carrying; and the great difference between glacial deposits and water deposits is that the ice deposits are entirely unstratified. A glacier, no matter how sluggish its movement, will carry a block of stone that weighs a thousand tons with just as much ease as it does the finest particle of dust; so when the glacier is melted, down goes everything in a promiscuous heap; and you will find these vast boulders, sand and gravel, earth and soil, all mixed together without the slightest arrangement. That is the terminal moraine.

Besides these, we also get lateral moraines, because, when the glacier is shrinking, it does so not only from the end upward, but from the side, just as a river when its supply of water is diminishing, and it falls, retreats laterally into its channel; so that a glacier that has been filling the valley up to a certain level, when the climate becomes warmer or when the snowfall is diminished, does not cut down so far as it used to, but shrinks laterally, and the lateral moraine is left at one side stranded. The blocks of stone carried on the edges will be left behind. There is a great block of stone in eastern Long Island about half the size of this building; another great boulder on the edge of a cañon in the plains measuring twenty-four feet in diameter, with estimated weight of twenty thousand tons. Sometimes these great boulders are let down so gently by the shrinking ice that they make rocking stones, and you may move backward and forward with your hands a great boulder that weighs a thousand tons or more. There are plenty of such instances.

Besides these general masses of moraine material, there are constructions around, in and underneath the sheet, especially at its edges, produced by the combined work of water and ice. Every stream of ice has water flowing under it. Even in Greenland there are subglacial streams; in the fiercest frosts of an Arctic winter the stream of water issues from underneath the ice. Ice is an excellent non-conductor, and protects the subglacial stream from the action of the intensely cold atmosphere.

Some of these subglacial streams are very swift. Glaciers always flow down considerable inclines, where water rushes with torrential violence. They flow through in channels they make by melting their way. In the glaciers great streams flow beneath the lake of ice from the north, pass under its whole length and come out at the south. Many of these streams are under tremendous head, as the engineers would call it, and so loaded with gravel and sand that when they come out to the surface they rise up as huge fountains, sometimes twenty feet high, and, of course, their velocity is immediately checked and they choke themselves with sand and gravel, forcing themselves to melt out new channels.

When the ice has retreated by melting, these subglacial stream channels would be left standing as long, winding ridges of gravel and sand. These have been actually observed in process of formation in Alaska in a glacier which is retreating very fast. In the last hundred years it has gone back a mile or two. It used to be in the sea, and now it is not within a mile of the sea, and instead of the ice-covered area, we have a delta area, where innumerable streams are coming out from the ice and depositing these materials.

In regions like Central New York and New England and Central Illinois we find a great many eskers where these ice streams originally were. These eskers come together exactly like streams, and evidently are old subglacial stream channels choked up by the action of the ice. These eskers (or, as they are called in Scandinavia, asar) are a very conspicuous topographical feature.

Another topographical feature produced by the glaciers is kames—short hillocks or ridges of drift gravel, sand and the like formed on the edge of the ice front. These fronts are irregular at the base. A stream of water coming out from under the ice at this point under great pressure spouts up a fountain, throws out sand and gravel and fills up an area with a mass of partially stratified drift, which, when the ice melts and goes back, will be left standing as an isolated hillock or kame.

Drumlins.—Thousands have been found in the glaciated regions of this country. They also have been produced near the edge of the ice front; and their manner of formation is a very complicated one. Below the front of the ice where the escaping waters come out we have the material that these glacial streams were carrying, spread out in sheets. If the subglacial stream happened to find a valley ready to receive it, it flowed down the valley, leaving the coarsest material up at the top and finer and finer as it got down. These

\* Vol. I, p. 54, Series VI.

† See "Sacred Formulas of the Cherokees, Smithsonian Report, 1885," Mooney, pp. 361, 364.

‡ The healing power of the wedding ring was communicated to the finger upon which it was worn, which was supposed to cure any sore or wound stroked by it, all the other fingers being injured, and the physicians of Greece and Rome used it to stir their medicines. See Chambers's "Book of Days," February 3.

streams of glacial material thus left in the valleys are called valley trains, and are due to the material prepared by the glacier and carried off by the swiftly moving water. If these streams were carried onto a plain, they would deposit most of the material which they would carry. Then we get a glacial sand plain, produced by the waters escaping from under the edge of the ice front.

So we see glacial topography, whether of destruction or construction, is pre-eminently characteristic. It is a mountain flowing torrent with no crags in it. Wherever the ice has overflowed the rocks it has covered them and polished them. Two or three hundred feet is perhaps the limit of height. The winding drumlins all formed in this one kind of way and no other.

### THE KLONDIKE GOLD FIELDS.

THERE is always something particularly exciting about the discovery of a new El Dorado; so that when, on July 14, the stories of the fabulous richness of the new Klondike, near the upper Yukon River, just over the border of Alaska, in British America, were confirmed by the arrival of forty miners with gold amounting to over \$500,000, an exodus of miners began at once.

The Klondike gold fields are not in Alaskan territory, as was originally supposed; they are in the British provinces in what is known as the "Northwest Territories." The Klondike River, which has been on the map for about twenty years, but not under that name, is a branch of the Yukon River. The gold fields are most easily reached from Chilkoot Inlet. Steamers run there from Sitka and from Seattle and Tacoma. The distance from the head of Chilkoot Inlet to Klondike is about 500 miles. To reach there it is necessary to cross the coast mountains and the chain of lakes and short streams which form the head waters of the Yukon River. It is along these streams the gold is found. The country is a rolling one and is covered with grass and subject to great extremes of heat; so that the mortality among the miners will probably be very high. There is a short, hot summer of four months, with practically no spring or autumn. The ice does not break up until about the last of May, when navigation commences on the Yukon River. By the latter part of September it gets very cool. Winter comes about the first of October, and it is very cold and dry, with little snow and rain. The thermometer sometimes falls 68° below zero in January and February, and sharp winds are prevalent. The dress of the natives and the miners is mostly of fur in winter. Dr. W. H. Dall, one of the curators of the National Museum, who has spent much time in Alaska, states that gold was first discovered there in 1866 and has been taken out in profitable quantities for fifteen years or more, but nothing like the boom of the last few weeks has ever visited the gold fields. The gold bearing belt of northwestern America contains all the gold fields extending into British Columbia and what is known as the Northwest Territories and Alaska. The Yukon really runs along that belt for from 500 to 600 miles, the bed of the river being in the valley. Gold is not found in paying quantities in the main river, but in the small tributary streams which cut through the mountains. In most cases the gold lies at the bottom of thick gravel deposits.

There is another method of reaching the gold fields. This is by the Yukon River, though it is much longer, being 1,500 miles. Flat bottom steamers run from St. Michael's up the Yukon. The return trip is usually made by these steamers. As the gold fields are situated in a country where there is practically nothing upon which to subsist, it is necessary for the miners to carry enough supplies to last a year. Even last winter, when the number of miners was very limited, the supply of food was inadequate, and rations had to be doled out. The several thousand miners who are now on their way to the Klondike, many with inadequate provisions, bid fair to cause one of the greatest catastrophes in mining history. Canada is quite aroused over the discovery of gold in the northwest provinces. Custom house officers and mounted police are being rapidly dispatched toward the frontier.

The miners who have returned to San Francisco bring startling tales of the marvelous finds of gold which discount the stories of 1849. The excitement on the river is indescribable. One man has worked forty square feet of his claim and obtained \$40,000 in gold dust. The estimated extent of the district is thirteen square miles, and it is thought that the claims will average \$300,000 and some are valued as high as \$1,000,000. Labor costs \$15 a day and upward. Some of the miners who have returned to San Francisco brought from \$60,000 to \$150,000 as the result of their few months' work. The method of mining is to remove the surface mass, which is eighteen inches thick, and then build a fire which burns all night. In the morning the gravel is shaved down about two feet; this is shoveled out and another fire is built. In this slow and laborious way the ground is removed to bed rock. This work can be carried on all winter, and there is so much labor connected with it that there is little wonder that the price of employment is so high. All provisions are scarce and dear. Last winter eggs sold at four dollars a dozen and flour at a dollar a pound. It is a curious fact that the Klondike gold is inferior to that obtained in California, or even in other localities near the Yukon. It averages only \$15 per ounce, while gold from the regular districts in California averages from \$18 to \$19 per ounce. As the yield will amount to millions of ounces per annum, the difference is a vast one.

The steamer Excelsior on her next trip from St. Michael's, which will be about September 5, will bring between \$5,000,000 and \$6,000,000 in gold dust. The transportation companies are taxed to their utmost, and more than five thousand miners are expected to reach Klondike next fall, and it is said that fully twenty thousand would attempt to go there if they were assured of transportation.

The story told by the returned miners is that rich discoveries have also been made in Alaska, just over the border. In fact, it now appears that the rich promise of the whole region has not been a secret among the northern gold hunters during the last few months, but the fame of the Klondike region has become such that every one wished to hurry to that region. It is expected that every mail from Alaska will bring the news of other gold fields which are comparable to those of the Klondike.

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